Veterinary Service *in* Wartime

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in

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The 30th Veterinary General Hospital, halted in Guadalupe Pass for sandwiches, December 5, 1941. The organization was on a three-day practice "march." Only one-half of the personnel could go on these marches since the hospital was functioning for training purposes at the time and had in its surgical wards about 100 ailing horses which had to be cared for by those remaining. The mountain in the background is El Capitan, the highest peak in Texas. Evidence indicates that from time immemorial Indians used this peak as a look out, and as a point from which to signal to desert tribes. For more than 200 years, the early Spanish missionaries, the Conquistadores and in turn the settlers used it for the same purpose. The American Army established a signal and lookout point on the top of this mountain in 1847 and maintained it intermittently until the telegraph made it unnecessary. The peak is visible for 75 to 100 miles in all directions and it is said smoke signals from its summit can be read from an even greater distance. It was not until the veterinary organization returned to its home station at Fort Bliss the evening of December 7th that the personnel learned of the attack on Pearl Harbor. Incidental to this practice trip the organization toured Carlsbad Caverns in New Mexico

Army Veterinary Service

THE veterinary service of the United States Army during the War Between the States was supplied by a personnel selected from the troops. Men with special aptitude but without scientific training were chosen to treat the ailments of government animals. They were given the rank of sergeant major. The result of this policy was a great disappointment and entailed much criticism, both in and out of the army. In 1863, owing principally to disease among the animals, the army in West Tennessee required 150 horses and the army of the Potomac 500 daily for replacements. The most unfortunate result of this unscientific policy of using untrained personnel for disease control was the spread of disease among animals of the civilian population by the sale of unfit horses. Glanders was a rare disease in this country until after the Civil War, but diseased horses sold by the army during and following the Civil War spread it to every county and city east of the Mississippi River, and it was not brought under control until the end of the century—more than a generation later. In the meantime the cost of this disease to farmers and owners of horses in cities mounted to hundreds of millions of dollars.

Following this disastrous experience, the Army veterinary service was reorganized (in 1868), and provisions made that only graduates of veterinary colleges could be appointed to the position of army veterinarian. This brought about an improvement in the service, but it was not until 1902, 34 years later, that the spirit of the regulation was carried out by appointing only graduates from recognized veterinary schools, and then only after an examination that eliminated the unfit.

The improvement of the army veterinary service following the changes of 1902 was so marked that it was obviously but a matter

Brigadier General R. A. Kelser, Chief of the Veterinary Service, Surgeon General's Office, War Department and other officers of the Veterinary Corps meet with officers of Wilson & Co., to discuss the preparation and packing of food products for the Army. Left to right (seated): A. A. Dacey, Executive Department and H. J. Williams, Vice President of Wilson & Co.; Brig. Gen. R. A. Kelser; Left to right (standing): Lieut. Col. Fred C. Waters, Depot Veterinarian (Chicago Quartermaster Depot); Dr. H. E. Kingman and Dr. R. F. Vermilya of Wilson veterinary department; Col. Seth C. Dildine, Headquarters' Veterinarian of Quartermaster Perishable Subsistence Branch; Col. James E. Noonan, Sixth Service Command Veterinarian; G. B. Thorne, Executive Department of Wilson's; Lieut. Col. Louis L. Shook, Director of the U. S. Army School of Meat and Dairy Hygiene, conducted at the Quartermaster Depot, Chicago, Illinois; Harold Graham, Superintendent's Staff, Wilson & Co.

FORGE ROOM HORSESHOEING SCHOOL, FT. RILEY

The Army requires many horseshoers. All are trained in schools conducted by veterinary officers. Sometimes officers take the course. The first two forges at the right above are manned by captains (cav.).

of time until this service would be placed upon a strictly professional basis analogous to that of the medical service. This was done in 1916, when the veterinary service was, by act of the Congress, made a part of the Medical Department of the army, and army veterinarians were commissioned in grades from second lieutenant to major and during the World War to the grade of colonel and in the present war, by order of the president, to that of brigadier general.

The veterinary service as a part of the Medical Department of the U. S. Army is charged with a dual responsibility which falls under two general heads: the care and treatment of animals and the inspection of food supplies of animal origin for the army personnel.

With reference to animals, the veterinary service is responsible for investigating the hygienic and sanitary conditions under which they are kept and for making suggestions and recommendations for their improvement and for increased efficiency. It instructs the military personnel in animal sanitation and management. The scope covered under animal management in general includes: feeds and feeding, watering, grooming, exercise and horseshoeing.

The subject of horseshoeing is especially stressed, since the army must train its own horseshoers; the art and science of shoeing horses are fast becoming unknown in civil life. Three large horseshoeing schools are maintained for this purpose. They are located at Fort Riley, Kans.; Fort Sill, Okla., and Fort Bliss, Tex. Especially selected soldiers are sent to them for a five-month course. In addition, short courses are given at other stations where animals are kept. All of these schools are under the supervision of veterinary officers.

Another responsibility of the veterinary service is the physical examination of animals before purchase for the army, and before condemnation as being of no further use in the military service.

The inspection of all hay and grain before purchase by the Quartermaster in the United States and our foreign possessions is another function of the veterinary service. As an indication of the magnitude of this service in peacetime, the records show that 191,410,886 pounds of forage was inspected during the fiscal year ending June 30th, 1940, and that of this amount 15,235,376 pounds were rejected as not meeting the specification requirements. This resulted in a large saving to the Government. Of course, the purchase of grain and hay are much greater now.

A further responsibility of the army vet-

Signal Corps, U. S. Army

INSPECTION OF TURKEYS AT THE SCHOOL OF MEAT AND DAIRY HYGIENE, CHICAGO
Left to right: Lieuts. Myron Thom, Hugh D. Smith, Orlen L. Bailey (front view), J. B. Couch, and Ralph A. Maxwell

erinarian is the management of veterinary military hospitals and the personnel of all other veterinary units, also the training, instruction and assignment to duty of commissioned and enlisted personnel of the veterinary service.

The evacuation and care of sick and wounded animals; the institution of suitable protective measures to prevent the introduction of communicable diseases; and the prompt detection, proper handling, (including isolation and quarantine), and application of curative measures to affected animals and those suspected of disease, constitute another extremely important function of the army veterinary service.

Placing the responsibility for the inspection of food for the army personnel upon the veterinary service was a natural outgrowth of experiences with poor quality foods during the Spanish American War—particularly the embalmed beef scandal. When the army set about developing a personnel to pass upon, and guarantee, the quality of its food, it was soon realized that its veterinary officers alone had the requisite scientific training in animal pathology to determine the healthfulness or otherwise of the animals from which its principal foods are derived and the wholesomeness of the meat and meat products, milk, butter, cheese, ice cream, eggs, fish, etc.

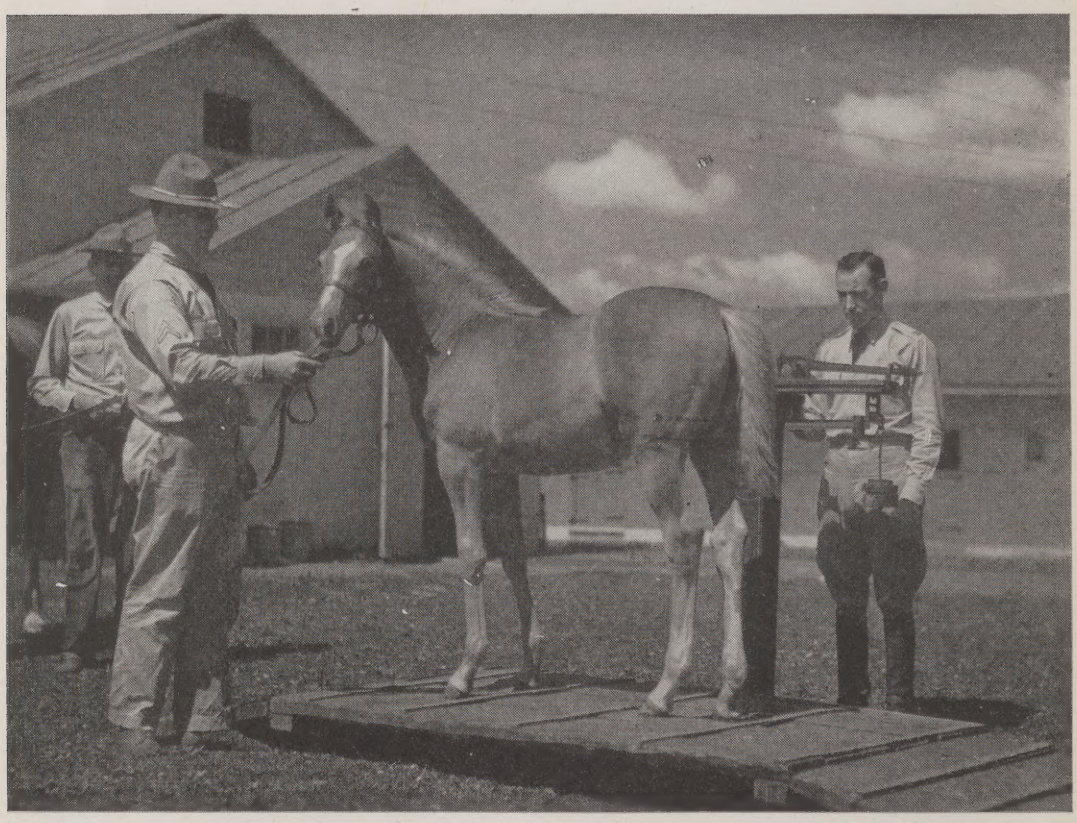
The army recognizes and accepts the inspection service of the Bureau of Animal Industry insofar as it covers the ante- and postmortem examination, but charges the army veterinary service with the inspection for class, type, quality, grade and sanitary conditions and, where B.A.I. inspected products are not available, with ante- and postmortem inspection of food animals and sanitary inspection of food processing establishments. This inspection is a safeguard to the health of the soldiers and is of inestimable value to the military service.

Again referring to peacetime activities, it may be of interest to mention that during the fiscal year ending June 30th, 1940, the

army veterinary service inspected, both before purchase and at the time of issue to the troops, a total of 421,820,575 pounds of such items as beef, pork, mutton, poultry, fish and dairy products. Of this amount 8,912,704 pounds were rejected as not conforming to the government specifications, resulting in a saving to the Government of $614,308.73. To be applicable at the present time, it is probable that all the foregoing figures should be multiplied by 25 because of the vast increase in the size of the army since then. In addition to the army, inspection was furnished for the U. S. Soldiers Home in Washington, the Veterans Administration, certain U. S. Naval stations, the National Guard, the Works Progress Administration, and the Civilian Conservation Corps.

■ Veterinary officers are assigned to duty at the Remount Stations at Front Royal, Va.; Fort Reno, Okla., and Fort Robinson, Neb. They perform the important duties of testing for sterility remount stallions and mares maintained at the remount, and those stallions placed among the civilian agents for breeding purposes in their respective areas. This includes 700 stallions at the present time. One hundred sixty-seven government-owned mares were bred at the three remount stations during 1940, resulting in 123 living foals, 30 days after birth. About 40% of the mares were artificially inseminated by the use of capsule or syringe.

Glanders has been practically eliminated from army animals by the veterinary service due to the precautionary measures of mallein testing, hygiene and quarantine. Only three cases occurred during the calendar year 1939 out of a total of 23,432 animals; no cases were found among 50,000 animals in later tests.



At the remount station, Front Royal, Va., the army veterinary service has, in addition to the usual station duties, the responsibility for supervising the breeding activities and research into diseases incident to reproduction

There were 185,000 cases of encephalomyelitis among the horses of the civilian population during the year 1938 and many cases each year since that time. All animals in the army were vaccinated in 1939 and each year since with a vaccine prepared at the Army Veterinary Laboratory in Washington, with the result that not a single case has occurred among army animals in the past three years.

All horses and mules are protected annually against equine encephalomyelitis by the use of vaccine prepared at the Army Veterinary Laboratory in Washington, at a great saving to the Government. All government animals are given also tetanus toxoid, and such as are taken into districts where anthrax is enzootic are vaccinated against that disease.

Veterinary laboratory service is conducted at the Army Medical Center, Washington, D. C.; the Station Hospital, Fort Sam Houston, Texas; the General Depot, Fort Mason, California; the Research Laboratory for Animal Diseases, at Front Royal, Va., and at the Chicago Quartermaster Depot.

The following biological products were prepared during the year 1940 at the Army Veterinary Laboratory, Medical Center, Washington, D. C., for use in connection with army animals:

Antigen—Autogenous; equine infectious abortion	965cc
Bacterin—Autogenous; equine infectious abortion	6,615cc
Blood—Defibrinated; horse, sheep and rabbit	28,230cc
Mallein—Intradermic	91,905 doses
Mallein—Crude	4,715cc
Serum—Anti-strangles, equine infectious abortion, and normal horse	45,110cc
Tuberculin—Intradermic	14,120 doses
Tuberculin—Crude	650cc
Vaccine—Equine encephalomyelitis;	
Western type	579,309cc
Eastern type	358,199cc
Bivalent type	18,000cc

A small section of the extensive exhibit of the Army Veterinary Corps of the United States Army at the A.V.M.A. meeting held in Chicago, August 24-27, 1942. All cuts of beef, veal, pork, mutton, lamb and other foods of animal origin were exhibited in showcase refrigerators, and on top were displayed large photographs, showing various processes in the manufacture of the foods. At the left is pictured Col. J. E. Bastion, Chief Medical Branch, Headquarters 6th Service Command and at the right Col. James E. Noonan, Veterinarian, 6th Service Command

Biologic Warfare

Belligerents are not always governed by peacetime international treaties or agreements. Marshall Foch once stated, "When a people puts its entire force into a war it is difficult not to use all arms, even though prohibited, if there is hope of victory in them." There is a general agreement among high military authorities, that no country deprive itself of effective weapons used by the enemy. Ramsay McDonald, former British premier, has been quoted as saying belligerents have the right to use any arm capable of bringing victory to them. A German view is expressed by Captain Meyer (Volkszeiting 2-11-21), who declared: "The country that discovers the most virulent microbe for scattering over the enemy and that has the most effective vaccine to protect its ownself will be victorious."

Parasites are capable of destroying much of the plant and animal life required in the successful prosecution of war. But whether they can be intentionally implanted in such a way as to become a useful arm of offense is a debatable question among military scholars. One group contends that a biologic or microbe arm in the military service is not practical, another group fears its potentialities, and a third group declares that no one, in the light of present knowledge, is justified in taking a positive stand on either side of the question. There is general agreement, however, on two counts: (1) If victory can be thus achieved, the method will be used, and (2) the defense against such an arm must be as well prepared and organized as the offense.

During the past decade, German and French veterinary periodicals have included much discussion of biological warfare. Rinderpest, foot-and-mouth disease, contagious pleuropneumonia of cattle, glanders, anthrax, hog cholera, brucellosis, psittacosis, tularemia and others are named in the category of animal diseases belonging to the microbic arm, and various plant parasites are pointed out as means of curtailing and corrupting food supplies.

While some writers contend that the danger is minimal, because for each of the known infections there are protective measures, others point out that such measures (vaccines, serums) are not generally available in sufficient quantity. Instances in which armies have been defeated and wars lost because of diseases among soldiers are

familiar to every student of history. To deprive an army of sufficient food would hamstring it not less certainly than incapacitating it by infection; in fact might lead to just that. Disorganization, inescapable under the conditions obtaining in time of general mobilization, might make the suppression of epizootics difficult or impossible. Supported by a blockade, this might be decisive, and one is naive indeed who thinks this means would not be used by our enemies, if such were thought to be the case.

The conclusion seems inescapable that our military veterinary service should be prepared to combat intentionally implanted epizootics, not only among army animals but among those of the civilian population of occupied countries and that this preparation should include the immediate availability of the prophylactic requirements in any quantities that may conceivably be necessary. The possibilities of microbic warfare are so full of unknowns that the science of bacteriology should not fall asleep under the anesthetic of fancied security. Eleven "fifth columnists" were sentenced to death, in Russia in 1938, for "systematic weakening of agriculture by causing the death of 90,000 cattle." They had engaged in bacteriological sabotage.

Communicable Disease Problems of the Veterinarian in Wartime

Introduction

The President's statement, that American troops will be sent anywhere in the world where the enemy is to be met, places an obligation on veterinary Army officers to review and familiarize themselves with animal disease conditions all over the world.[1] Such information should include not only indigenous diseases of the soliped in all of the continents and most of the nations but also the prevalent diseases of food-producing animals of those areas, since on occasion it may be necessary to purchase locally food products of animal origin, to supplement the ration of the troops.

Veterinary vital statistics are incomplete in many nations involved in the present war and non-existent in still more of them. Perhaps there is no better way of determining what diseases and parasitisms of military importance may be encountered by a military expedition in various lands, than by a review of the experience of our own and the British veterinary service in the first World War, supplemented by recent veterinary literature. The discussions herein were prepared in this manner. Not all the diseases enzootic in any area are listed but it is believed the list includes the majority of those in each continent which are likely to prove of major importance to an American military expedition. The more important animal diseases indigenous to this country, for which control measures differ materially in the army from the usual practice among the civilian population, are included also.

That the problem of handling exotic diseases will be very real in expeditionary forces is indicated by the fact that animal plagues unknown in this country are rife in the islands of the Western Pacific. Rinderpest, foot-and-mouth disease and anthrax are prevalent in China, and every known infectious disease of domestic animals, except some African trypanosomiases and possibly hog-cholera, is indigenous to the Middle East. Native diseases not regarded as of significance to army animals in this

[1] At the beginning of the present fiscal year (July 1, 1942) U. S. Army detachments were stationed in nearly a hundred different locations in 31 foreign countries. By November, American troops in foreign countries exceeded 800,000, exclusive of Navy and Marine corps personnel.

country are important in some foreign lands, e.g., the British army veterinary service had to contend with rabies in horses in the Balkan Peninsula during World War I.

The information here given is an abridged compilation which it is hoped may prove useful to our several hundred subscribers now in the military service and to civilian practitioners in detecting outbreaks of foreign plagues among civilian-owned animals should any such occur as a result of sabotage. This discussion is not intended as a substitute for the more comprehensive treatises available on various of the diseases mentioned, but rather as a "refresher" on those subjects.

The need during wars for unusual alertness on the part of livestock sanitary officials and veterinary practitioners upon whom devolves the responsibility for the control of disease among food-producing animals which, of course, includes horses and mules since, in large measure, they supply the power necessary to operate farms —the primary food factories, is forcefully, yet conservatively stated, in the following editorial from the *Canadian Journal of Comparative Medicine*:

"Great Wars have always brought about conditions conducive to the spread of infectious diseases. The increased tempo and extension of transportation makes possible a rapid transference of infecting agents and, in some unknown way, conditions arise which favor the spread and increasing virulence of bacterial and virus invaders. Consequently infections which are ordinarily of minor importance assume great proportions and pathological processes previously unknown arise. For example, the cutaneous form of Preisz-Nocard disease had little significance before the last war but during that period it assumed the aspects of a widespread epizootic and caused the loss of thousands of animals. Swine influenza arose during the same period and trench fever was added to the growing list of infections.

"In earlier wars great infections swept over the warring nations and in many instances almost destroyed the herds of belligerent countries. There is every reason to believe that history will again repeat itself and never has the veterinary profession in Canada been presented with a greater opportunity for service than at the present time. On the shoulders of each veterinarian, whether he be practitioner, field officer or laboratory worker, reposes a grave responsibility for the health of the herds and flocks of this country. Every veterinarian is conscious of this and is particularly anxious to do his duty but some find difficulty in discovering how best they may serve.

"Without going into detail it can be said that the first duty of members of the veterinary profession is to be conscious of the likelihood of new infections arising and consequently to be alert. This, of course, pre-supposes that members of the profession fit themselves by a closer study of diseases which are either absent from or seldom found in this country. For instance, the reader may ask himself if he is familiar with malignant catarrh. Could he recognize this infection and differentiate it from rinderpest? Infectious stomatitis and vesicular exanthema are also diseases capable of assuming considerable proportions. Could the reader diagnose these conditions and differentiate them from foot and mouth disease? Other examples might be given but the fact remains that each member of the profession should get down his textbooks immediately and familiarize himself with diseases which are seldom if ever found in this country in order that, should the occasion arise, he will be prepared to recognize them and deal with them effectively.

Dr. C. C. Hastings, secretary of the Illinois Veterinary Medical Association, in a letter to the veterinarians of his State stresses the importance of practitioners remaining on the alert to detect outbreaks of infectious disease among live stock at the earliest possible moment. To quote:

"At this time when human food of animal origin is so important, every possible precaution should be taken to keep our farm live stock healthy and productive. When it is so easily possible to infect our herds and flocks with foreign animal plagues, it is imperative that every veterinarian not actually needed in our armed forces be kept in daily contact with our food-producing animals. Ordinarily a communicable disease is not difficult to control, if proper measures are inaugurated early in the outbreak and vigorously prosecuted.

"Veterinary practitioners are the sentinels of our animal population and a sufficient number should be on duty at all times to guard the health of our farm animals."

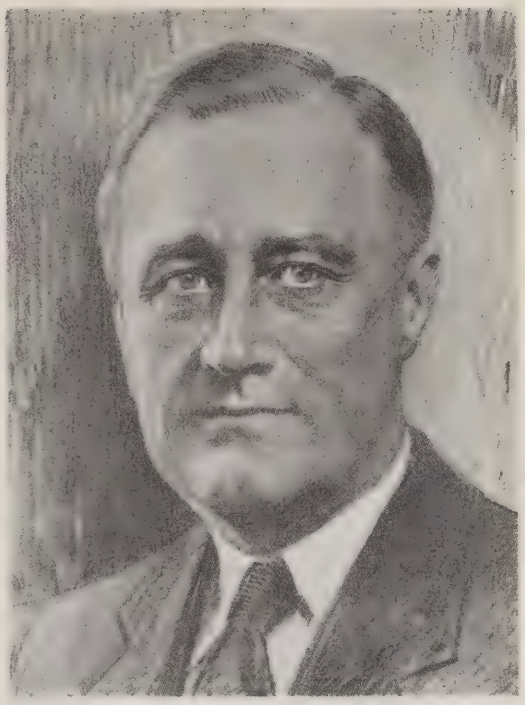
For those in the military service there is the further need for renewed study of animal plagues because of their greater severity under wartime conditions and the increased virulence of common diseases under tropical conditions. Mange and ringworm in horses are veritable scourges among military animals. Microbes are still miles ahead of man in adapting themselves to life in the tropics.

Medical Preparedness

The Medical Corps of the Army has made special preparation to meet the medical needs of our troops in every part of the world. The Veterinary Corps cannot do less to prepare its officers to meet the veterinary problems peculiar to the tropics, the arctic, mountain, jungle and desert regions.

A full two years before war was declared the Surgeon General's Office began the collection of medical data from every region on the globe—about the malaria situation throughout the tropics and beyond; dengue fever in China; filariasis in India; sleeping sickness in Africa; frost bite in Iceland; venomous snakes on the Gold Coast, the habitat of poisonous insects and disease conveying lice, ticks, etc. The health organizations in every country were studied and lists made of individuals who might give newly-arrived army doctors information about local disease conditions. Surveys of buildings which might serve for emergency hospitals have been made in all countries and complete information garnered about water supplies, ice plants, etc.

When a troop organization departs for any foreign station, its medical officers are supplied with a mimeographed pamphlet giving pertinent facts about the disease situation at its destination. These facts often include bits of unusual information, e.g., in instructions going with an organization to Africa it was noted that poisonous scorpions frequently crawl into mens shoes at night, for warmth, and bite if a foot is shoved down onto them the next morning. Organizations going to the South Pacific received caution about poisonous sea snakes and clams big enough to close over a man's foot when stepped upon. In the jungles of Malaya and Burma men are attacked by voracious leeches which must not be pulled off lest the head remain buried, but which quickly detach themselves when touched with the lighted end of a cigarette. An organization going to Trinidad carried the information that even in arid regions of the island as much as 70% of the native population is infected with malaria. The reason: The district is infested with a mosquito that breeds in water collected and held by



THE COMMANDER-IN-CHIEF

a parasitic plant that grows in the top of immortelle trees. By cutting these trees about camp areas the mosquitoes were eliminated and the chance of malaria infection greatly lessened. If the coast where the troops are to be landed is mosquito infested the men are cautioned to wear headnets if debarked at night. The neglect of this precaution by British troops in one instance resulted in one-third of the organization acquiring malaria from a single night's exposure. Other organizations are cautioned against bats that carry rabies; to avoid water holes in Australia which are frequented by aborigines (because of hookworm); in other places against flukes that burrow into the skin. They are told what to do in a sandstorm or when lost in a jungle; which fruits to eat and which to avoid and they are given up-to-date information on epidemics present in the districts to which they are to go.

The need of veterinary officers for global information on livestock disease is not less urgent than the need of the medical officers for information on disease conditions that may affect the health of troops.

Trypanosomiasis

Trypanosomiases include a group of serious diseases (surra, murrina, dourine, mal de caderas, tsetse fly disease, African sleeping sickness, etc.) one or more of which may affect almost any mammal. Their distribution is world-wide.

Trypanosomes are one-celled, protozoan parasites belonging to the flagellates. They are usually characterized by a delicate, undulatory membrane attached to the body and a whip-like flagellum that effects movement either forward or backward.

Many species of trypanosomes live in the blood of man and lower animals, always in the plasma—never in the blood cells. Some species are nonpathogenic; a greater number of the known species are harmful. The trypanosomes are responsible for important diseases of domestic animals in the United States and its possesions, including surra, caused by *Trypanosoma evansi*; murrina, caused by *Trypanosoma hippicum;* and dourine, caused by *Trypanosoma equiperdum*. A South American trypanosome, *Trypanosoma equinum* causes mal de caderas in horses and mules over a wide area in that continent. In Africa, *Trypanosoma brucei* causes tsetse disease, *Trypanosoma pecorum* and *Trypanosoma vivax* produce trypanosomiasis in cattle. *Trypanosoma gambiense* and *Trypanosoma rhodensiense* cause sleeping sickness in man.

Usually a given species is pathogenic for one animal and innocuous for another living in close association with the susceptible species. For example, the *T. hippicum* is non-pathogenic for cattle but fatal to solipeds. Big game herbivora, in certain parts of Africa, serve as carriers of *T. pecorum* and *T. vivax* which are highly pathogenic to cattle. Cattle serve as reservoirs for *T. evansi* which is fatal to solipeds and somewhat less pathogenic for camels.

Biting flies are the principal vectors of surra. Various species of tsetse flies are intermediate hosts of the trypanosomes causing trypanosomiasis (nagana) in Africa. Murrina (*T. hippicum*) is transmitted by the bite of the vampire bat as well as by biting flies. Dourine (*T. equiperdum*) is an exception in that transmission is direct from animal to animal through coitus.

Trypanosomes occur in the peripheral blood stream in large numbers only intermittently. If a blood sample be taken when they are plentiful they are easily identified by microscopic examination. To a drop or two of blood freshly drawn (inside the upper lip is the most convenient place to obtain the blood sample) add an equal quantity of 5% solution of sodium citrate; place on a slide and examine under the high power of the microscope. The trypanosomes, if present, are readily seen swimming furiously across the field and knocking the red corpuscles about.

SPECIES OF TRYPANOSOMES[1]

A. *T. brucei* B. *T. vivax* C. *T. congolense*
D. *T. equinum* G. *T. theileri*
E. *T. equiperdum* F. *T. evansi*

Various of the pathogenic trypanosomes are indistinguishable microscopically, but a diagnosis of trypanosomiasis by a blood examination is ordinarily sufficient, since the location and the species of animals affected is usually an index to the disease and to the particular trypanosome.

Most trypanosomes are readily detected by a complement-fixation test. Since they are not constantly plentiful in the peripheral blood stream, this test is an exceedingly valuable one in suspected cases which are negative on microscopic examination.

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[1] The Internal Parasites of Domestic Animals, *Cameron*. Courtesy The MacMillan Company, New York.

Mal De Caderas

1. *Synonyms.*—Hip disease, baccy-poy.

2. *Geographical Distribution.*—Mal de caderas is prevalent over the greater part of South America.

3. *Cause.—Trypanosoma equinum.*

4. *General.*—Mal de caderas is a trypanosomiasis affecting horses and mules in the sub-equatorial regions of South America. The parasite very closely resembles that of nagana. Clinically the disease is very similar to dourine. Ruminants and swine are slightly susceptible to the disease by inoculation. Rats and mice may be infected readily by artificial means.

Solipeds cannot be infected by feeding but succumb to hypodermic inoculation. The natural means of transmission is unknown, but biting insects are suspected. In dry seasons there is little of the disease. It is most frequent in swampy areas and during exceptionally wet years. The course of the disease is from one to three months, except in Paraguay where a chronic form called baccy-poy, which means slow emaciation, predominates. The prognosis is always unfavorable.

5. *Symptoms.*—The first symptom noted in an attack of mal de caderas is a gradual emaciation notwithstanding the appetite remains good. Weakness of the hind quarters follows with a staggering gait, dragging the hind feet and giving down in the hocks. The paresis intensifies until the animal is unable to rise when down, and when helped up spreads the hind feet wide apart, stands unsteadily, and later becomes unable to stand at all. The anal sphincter is relaxed and the muscles of the rectum paralyzed in the final stages of the disease.

Throughout the course of mal de caderas the temperature fluctuates, ranging from normal in the morning up to 107° F. in the evening. Urticaria-like swellings in the skin are frequent. The urine contains albumin and sometimes blood and there may be a conjunctivitis.

Diagnosis is confirmed with the finding of the trypanosome by microscopic examination of the blood, or by inoculation of mice or rats. The trypanosome is plentiful in the peripheral blood stream only during exacerbations in the attack and can be demonstrated with the microscope only at such times.

6. *Treatment.*—No satisfactory treatment of mal de caderas is known. As with surra, human blood serum will destroy the organism but, of course, does not constitute a practical treatment.

A variety of arsenical and coal tar dyes have been recommended but have not withstood the test of time. Trypanred is effective against the organism in rodents.

7. *Prophylaxis.*—No successful preventive measures are known. Keeping the animals away from swamps should lessen the amount of infection acquired. Protection from biting flies by fly repellant applications, always worth while in the tropics, may help to prevent mal de caderas.

The hardy zebu ox is well adapted for draft in Brazil. It is immune to mal de caderas

Surra

1. *Synonyms.*—M'bori, rotten disease, el debab.

2. *Geographical Distribution.* — All of Southern Asia, Burma, French Indo-China, India, Arabia, Iraq and Iran, etc. Many of the islands of the East Indies, parts of Africa.

3. *Cause.—Trypanosoma evansi.*

4. *General.*—The trypanosome that causes surra is transmitted from animal to animal by biting flies, of which the tabanids are the most important. There is some evidence that these flies serve as both mechanical carriers and intermediate hosts of the trypanosome, but such is not generally thought to be the case. Fleas also, transmit the disease among dogs, rats and other rodents. Dogs sometimes acquire the disease also from eating the carcasses of animals dead of it. Dogs, monkeys, rodents, cattle, water buffalo and camels may act as carriers of the trypanosome. This was the first pathogenic trypanosome discovered. The discovery was made in India in 1880 by a veterinary officer of the British Army—Griffith Evans.

In regions where surra is indigenous it is usually mild or sub-clinical among the native ruminants. However, when introduced into new areas it may be destructive to the cattle. Under special circumstances the mortality may be high among camels, although these animals commonly carry the infection in their blood and serve as a reservoir of the trypanosome dangerous to other animals, without themselves exhibiting marked clinical symptoms.

The mortality approaches 100% among solipeds when introduced into new areas such as is likely to be the case during military campaigns. Military animals from districts where the disease does not exist are similarly affected when taken into districts where the disease is enzootic. In regions where biting flies are plentiful, surra has at times almost wiped out the horse population. As would be expected from a disease transmitted by biting flies, it is most prevalent at the close of, and immediately following, the rainy season and on low marshy land and along streams with tall vegetation that may harbor Tabanidae.

Armies operating in India and southwest Asia have usually found it necessary to augment their transport service with native camels and oxen. The majority of both animals in that section carry the trypanosome in the blood. They may or may not present clinical symptoms of the disease. However, when subjected to hard work the camels break down rapidly and suffer from clinical surra. More than 40,000 animals were lost by the British from surra in a single campaign in Palestine during World War I.

Surra is an outstanding example of a disease in which the veterinary service of a command not only has the obligation to prevent the infection of military animals from native animals, but also to protect the civilian-owned animals against infection from army animals in districts where the disease is not enzootic among native animals.

5. *Symptoms.*—The period of incubation is about 10 days. The onset of the disease is signalized by a harsh staring coat and in time the hair falls out in patches. The soliped loses condition rapidly and becomes "tucked up" to a remarkable degree, the eyes water and there is a thin discharge from the nose. Early in the attack weakness of the hind quarters becomes manifest. This progresses to partial paralysis; the animal dragging its feet and swaying as it walks. The anus is retracted and the sphincter relaxed.

Early in the attack there is edema of the sheath and inconstant swelling of the hind limbs. Edematous swellings commonly occur also on the brisket and in other dependent locations. These lesions grow progressively more marked with the progress of the disease.

The appetite remains good up until a few hours before death. Even when the animal is no longer able to stand and is suffering from extreme anemia and debility it will lie and eat almost greedily.

The temperature in surra is not uniform in characteristics. Early in the attack it may fluctuate between normal and about 103°F.

Later on it is prone to become sub-normal.

The diagnosis is confirmed by finding the trypanosome, *Trypanosoma evansi* (which is indistinguishable microscopically from *T. brucei*) in the blood. Many, a few, or perhaps none at all, may be found; the number apparently having little relation to the severity of the clinical symptoms. The experience of our army veterinarians in the Philippines demonstrated that the complement-fixation test is an exceedingly valuable means of not only diagnosing the disease but also detecting the carriers of *T. evansi* among the cattle and water buffalo. An antigen for this test was developed by Col. T. K. H. Reynolds, V. C.

Annual Meeting of the United Provinces Veterinary Medical Society of India

6. *Treatment.*—The treatment of horses and mules affected with surra is futile as practically all succumb in about six weeks.

Ruminants are less severely affected; with symptomatic treatment, rest and good food they recover in six to ten weeks. However, recovered animals continue to carry the trypanosome in the blood and, hence, constitute a hazard to susceptible animals, with which they may come in contact.

Army regulations require that immediately surra is diagnosed in an army animal, it shall be destroyed.

7. *Prophylaxis.*—Since biting flies are the agents that transmit *T. evansi* the problem of control and prevention of surra is considerably simplified. The tabanids, or horse flies—the principal vectors of surra, harbor in tall vegetation along streams or near swamps. Such places can be avoided or the vegetation can be cleared away before the horses are brought near them. If crossing such belts be necessary it should be done at night to avoid the flies. Smudge fires may be used when it is necessary to water animals where vegetation is tall.

These flies travel but a short distance and infection from native animals may be avoided by keeping them distant from military animals. It is essential that the horse bivouac be located as remote as possible from camel or cattle camps. One mile is considered a safe distance if no animals traverse the interspace.

Stomoxys, or stable flies, can be reduced in number by cleanliness about the stables and picket lines, and by the use of fly traps. The tabanidae (horseflies) by far the most important agent in the transmission of surra are readily reduced in number by killing them as they attack the animals. These measures afford considerable protection from the disease.

Suspected cases or contact animals should be kept in screened stables or isolated at least a mile from other animals.

In the presence of an outbreak of surra, a microscopic examination of the blood of all animals in the immediate command should be made daily, and the temperatures should be taken twice daily. Complement-fixation tests should be made of blood of suspected cases which are negative on microscopic examination. All animals, in the blood of which trypanosomes are discovered, and those reacting positively to the complement-fixation test should be destroyed immediately. All others showing a temperature above normal should be isolated.

Murrina

1. *Synonyms.*—None.

2. *Geographical Distribution.* — Central America, Panama, northern South America.

3. *Cause.—Trypanosoma hippicum.*

4. *General.*—Murrina is a fatal trypanosomiasis of solipeds. It is indigenous in the Canal Zone and the Republic of Panama and occurs in some other Central and South American Republics bordering on the Caribbean Sea. It resembles surra closely but is more chronic. House flies have been incriminated by some investigators as carriers of this disease but others hold that it may be transmitted direct from one animal to another. It is readily inoculable, however, and biting flies, particularly the tabanids, which are regarded as important agents in its transmission, should be avoided if at all possible.

The vampire bat (*Desmodus rotundus*) is susceptible to the trypanosome that causes murrina and it succumbs to the infection. It is generally thought, but perhaps not definitely proved, that this bat while carrying the trypanosome in its blood, may infect susceptible animals on which it feeds. In fact this bat is regarded by many as the most important agent in the transmission of the disease since it feeds upon cattle and horses indiscriminately. Cattle are unaffected by this trypanosome but carry it

In the West Indies stallions are preferred to mares or geldings for riding

in their blood for life, thus constituting an ever-present reservoir for the infection.

5. *Symptoms.*—About five days after infection, animals exhibit lassitude, weakness and fever. One to two weeks later subcutaneous edema appears underneath the chest and abdomen and in the sheath. Both the fever and the edema are of an undulant type, diminishing and recidivating throughout the course of the disease. Edema of the extremities and hemoglobinuria also ensue as the disease progresses. The appetite remains fair but there is a progressive loss

Common type of horses in the West Indies

of weight and an increasing anemia throughout the long course of the disease which runs from two to three months and invariably ends in death.

6. *Treatment.*—No treatment for murrina is known that is of any value.

7. *Prophylaxis.*—No measures effective in preventing murrina in districts where it is enzootic are known, other than keeping the animals in screened stables when not in use. As this is seldom, if ever, practicable in military campaigns, loss from this disease is to be expected. Early disposal of infected animals and keeping native cattle distant from horses and mules lessen the opportunities for infection.

The trypanosome, when found in the blood, confirms the diagnosis, made upon clinical symptoms. However the parasite is irregularly found in the blood stream. Experience in Panama demonstrated that the complement-fixation test is a valuable means of diagnosing murrina early in the attack and is routinely employed in that country.

Nagana

1. *Synonyms.*—Tsetse fly disease, African trypanosomiasis.

2. *Geographical Distribution.*—South and East Africa.

3. *Cause.—Trypanosoma brucei.*

4. *General.*—Nagana is a trypanosomiasis that, clinically, closely resembles surra. It is, however, limited to belts south of the equator in Africa—areas inhabited by the tsetse fly which is the only important, if not the sole agent, of transmission of the disease among animals. This fly acts as a vector and also as an intermediate host of the trypanosome. The disease is highly fatal to horses. A similar disease caused by *T. pecorum* or *T. vivax* is equally fatal to cattle and is transmitted in the same way as nagana. These trypanosomes together with the tsetse fly, have prevented the settlement of great areas of the equatorial belt of Africa and beyond. Trypanosomiasis has been responsible for disaster to military campaigns in that portion of the world.

During World War I, the British veterinary service estimated in advance that the East African campaign would result in a horse mortality of 30% per month and a total mortality of 100%. The prediction proved to be well founded since, the actual monthly mortality ranged from 32 to 38% of the animals taken into tsetse fly belts, and all were lost eventually.

5. *Symptoms.*—About 10 days after an animal is "fly struck" a syndrome sets in that is, in practically all respects, identical to that of surra. At first there is elevated temperature and staring coat; watery discharge from the eyes and nose, swelling of the sheath—later of the hind legs, and a loss of flesh. Sir David Bruce, discoverer of the trypanosome and for whom it is named, described the final stages in these words:

"He is a scarecrow, covered with harsh, rough hair, which has fallen out in places. His hind extremities and sheath may be more or less swollen, sometimes to a great extent, and he may become quite blind. At last he falls down, unable to rise, his breathing becomes shallower and shallower and he dies exhausted. During the illness he has shown no signs of pain and up to the last day has had a fairly good appetite."

Tsetse-fly
Glossina morsitans
(three times natural size)

Courtesy D. Appleton-Century Co.

Diagnosis is confirmed by finding *T. brucei* in the blood.

6. *Treatment.*—No treatment of any value is known for nagana in horses, mules or asses. One gram of tartar emetic, in aqueous solution (4%) administered intravenously every fifth day, is recommended by Edmonds for trypanosomiasis of cattle caused by *T. pecorum* or *T. vivax.*

6. *Prophylaxis.*—The tsetse fly loves shade and will not venture into open wind-swept areas. Keeping the animals away from timber belts or, when necessary, crossing them at night, meets with considerable success in preventing nagana. When animals are watered at fly-infested streams a smoke screen affords protection. The fly will bite at night, particularly in moonlight, if disturbed, although much less than in the day time. It has been noted that when travelling at night, animals toward the rear suffer far more from bites than those at the head of the column. It is suggested that the less valuable animals be put at the tail of the column. When animals are fed well, 10gm of arsenic daily will drive the trypanosomes from the peripheral circulation and thus lessen their infectiousness.

Since some native animals, including the big game animals, constitute natural reservoirs of the *T. brucei, T. pecorum, T. vivax* and other trypanosomes, all tsetse flies should be regarded as dangerous. In the acute stages of the diseases the organisms occur in the peripheral blood in enormous numbers and it is thought, but not proved, that any of the biting flies may carry the infection mechanically from the acutely sick to nearby well animals at such times.

Dourine

1. *Synonyms.*—Maladie du coit, equine syphilis; breeding paralysis, genital glanders.

2. *Geographical Distribution.* — Southern and eastern Europe, Africa, Asia, Brazil, Chile and a few districts in the United States.

3. *Cause.—Trypanosoma equiperdum.*

4. *General.*—Dourine is of little importance to military forces, except as it interferes with horse-breeding. Its chief interest to American veterinarians lies in the fact that it is the only trypanosomiasis of domestic animals that occurs in the continental United States. It was brought to this country from France in a stallion and first recognized in 1886 by W. L. Williams, then practicing at Bloomington, Illinois. Outbreaks of dourine have since occurred in Nebraska, South Dakota and Iowa, and it has been found among wild horses and animals belonging to Indian tribes in several of the Mountain States. At present it exists in only a few restricted localities in Arizona and California from which its eradication is probable in the near future.

Dourine is unique among trypanosomiases in that it is, in the main, communicated directly from animal to animal through coition and to a much less extent, if at all, by biting insects. The mortality rate is high, often 50% and sometimes much higher. The sterility rate as a result of infection is still higher. The earlier symptoms involve the genital organs in both sexes. Later the nervous system is involved. Rather rarely geldings contract the disease. Affected animals should be destroyed. Clinical diagnosis is sometimes difficult. A complement fixation test is of great assistance in the control and eradication of this disease.

U. S. Army Signal Corps

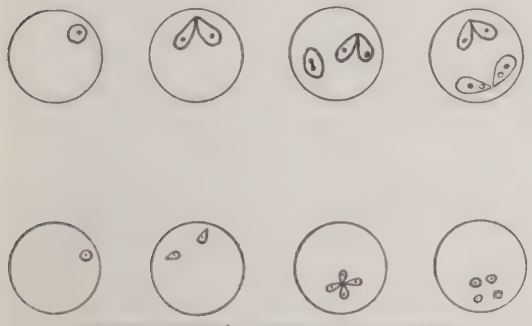
SEMI-TRAILER CARRYING A PORTEE CAVALRY SQUAD

These vehicles transport eight men and eight horses, together with equipment for both men and animals

Piroplasmosis

The piroplasmoses include a considerable group of diseases of mammals. They are caused by protozoa, that live and multiply within the red blood cells, thus destroying them and bringing about a severe anemia. The disintegration of the erythrocytes sets hemoglobin free. Much of it is eliminated in the urine resulting in hemoglobinuria; hence, a common name for babesiosis in cattle is red-water. Hemoglobin converted into bile frequently gives rise to icterus and is responsible for biliary fever in horses and malignant jaundice in dogs.

The piroplasmas are roundish, pear, ring, or rod-shaped (piro=pear, plasma=formed), unicellular organisms. They are transmitted naturally from animal to animal through the bite of ticks, and the diseases they cause may be communicated between animals of the same species by the artificial injection of blood containing the parasites.

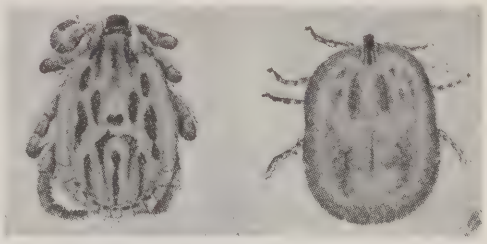


PIROPLASMAS[1]—division by budding
Above. *Babesia bigemina*. Below. *Babesia equi*

The piroplasmoses of cattle are more widespread than is equine piroplasmosis. Enzootic hemoglobinuria in Europe (*Babesia bovis*), Rhodesian redwater in Africa and Texas fever (*Babesia bigemina*), in America, are typical examples of such diseases in cattle. Piroplasmosis occurs also in sheep and goats (*Babesia motasi*), and in dogs (*Babesia canis, B. gibsoni*).

In horses as in cattle, in a region where piroplasmosis is enzootic, native animals suffer from a mild chronic form of the disease but, animals newly taken into such areas suffer acute attacks. Animals that recover from either acute or chronic attacks carry small numbers of the piroplasmas in the blood for long periods.

Two families of ticks, Argasidae and Ixodidae, about 10 genera and many species possibly may be involved in the transmission of piroplasmas among the mammals. A lesser number have been proved actually to inoculate animals.



***Dermacentor reticulatus.*[1] A, Male. B, Female. Dorsal view. *B. caballi* is conveyed by the imago of *Dermacentor reticulus* according to Marzinowski and Bielitzer in South Africa but du Toit found that the nymphs of the tick also carry the disease. The parasites are transmitted by the female to the next generation**

Ticks known to spread equine piroplasmosis are: *Rhipicephalus evertsi* (South Africa) and *R. bursa* (Italy) for the *Babesia equi* and *Dermacentor reticulatus* (Russia) and *Margaropus annulatus* (Italy) for the *B. caballi*. Ticks that transmit the piroplasma of bovine piroplasmosis are: *Margaropus* (*Boophilus*) *annulatus* (U. S.), *R. appendiculatus* (South Africa) and *Haemaphysalis punctata* (northern Europe) for the *B. bigemina* and the *Ixodes ricinus* and *H. punctata* for the *B. bovis*. The transmission of piroplasmosis of sheep and goats is effected by *R. bursa* and of dogs by *H. leachi, R. sanguineus* and *D. reticulatus*.

[1] The Internal Parasites of Domestic Animals, *Cameron*. Courtesy The MacMillan Company, New York.

[1] Hutyra, Marek and Manninger. Courtesy Alexander Eger, Publisher, Chicago.

Equine Piroplasmosis

1. *Synonyms.*—Biliary fever, equine malaria, babesiasis, babesiosis, nuttalliasis equorum.

2. *Geographical Distribution.*—Italy, Russia, the Balkan Peninsula, the Middle East, India, a large part of Africa and Central and South America.

3. *Cause.—Babesia (Nuttalia) equi* and *Babesia (Piroplasma) caballi.*

4. *General.*—Equine piroplasmosis is due to either of two species of piroplasmas. The *caballi,* a large pear-shaped organism, usually affects animals in hot weather and the *equi,* a small, round, oval or pear-shaped organism, only two microns in diameter, which is more prevalent in the spring. Both types of the organism are inoculable by subcutaneous or intravenous injection and both are naturally transmitted by the bite of ticks and possibly also by bites of flies.

In the Boer War the loss of British horses from piroplasmosis was very great. In World War I it was one of the principal causes of loss of British animals in summer campaigns in Palestine, Persia, Southwest Africa and Mesopotamia. It usually spreads rather slowly but may develop in a large number of animals within a few hours. The disease causes a long period of incapacity and may be an important cause, in fact the chief cause, of inefficiency in army animals in districts in which it is indigenous. Animals that have recovered carry the protozoa in the red blood cells for a long period, perhaps for life, and are thus a source of infection for animals with which they are associated. Further, such animals are prone to suffer relapses from overwork, exposure, or other hardship. Infections may be so mild in vigorous animals as to pass unnoticed and thus cause extensive spread of the disease. Such infections, however, do not remain sub-clinical. After running a chronic course, they result in anemia and debility. Should the animals contract an intercurrent disease or be exposed to severe hardship, serious illness is prone to develop. The incubation period of babesiosis is from one to three weeks.

5. *Symptoms.*—Pronounced dullness and depression throughout the attack characterize piroplasmosis of the horse. There is a continuous high fever during the acute stage, which lasts about six days. Thereafter, the temperature ranges from 102.5 to 104° F. The appetite is subdued and thirst augmented. The urine is increased in amount and high colored but in horses is seldom red as is the case in cattle. Visible mucous membranes are icteric or ecchymotic. There is a marked destruction of red blood cells and toward the end, a striking anemia. The disease produced by the *equi* is more severe than that caused by the *caballi* species.

Coincident with the high temperature the animal, if worked, suddenly shows great exhaustion and cardiac weakness. Exhaustion results also from exposure to hot sunshine. Later there are hemorrhages into the conjunctiva, icterus, polyuria, dark discolored urine, dyspnea, edema, emaciation and acute anemia. After the acute stage has passed the fever usually exhibits a periodicity, abating for a short time every third day.

With rest and good care the prognosis is favorable, but under less salubrious circumstances mortality may reach 50 and even 80% of the animals attacked. If the affected animals are worked during the pyrexial stage, sudden death is likely to ensue. Death occurring later is preceded by extreme exhaustion and debility. Diagnosis is confirmed by finding the pear-shaped piroplasmas in the erythrocytes on microscopic examination.

6. *Treatment.*—Free the animal from ticks, stable in the shade, give the best feed possible, provide complete rest and administer heart stimulants (digitalis, camphor).

Trypanblue has been used and highly recommended in various countries for *B. caballi* infections. It is given intravenously, 200cc of a 2% aqueous solution. Arsenous acid, atoxyl, mercury biniodide and potassium iodide all have been recommended. Trypanred also has its advocates, as does one gram doses of trypaflavine intravenously in 20cc of distilled water. Udall recom-

mends one gram of trypaflavine intravenously in 1000cc of distilled water. None of these treatments possess any value where the infection is *B. equi.* More recently Yakimov in Russia has reported encouraging results in the treatment of *B. equi* with acriflavine.

During World War I, the British veterinary service relied entirely upon intravenous injections of quinine acid hydrobromide and reported that few animals which received injections early in the attack and had good care thereafter were lost. Thirty grams of the drug was given in 30cc of water once a week.

American Army veterinarians experienced excellent results in Panama Canal Zone from the use of arsphenamine and neoarsphenamine. The use of one or the other of these drugs is now routine treatment of the disease in our army. The usual dose is 3.5gm in 100cc of distilled sterile water, administered intravenously. This injection is usually repeated three times at 48-hour intervals and, after a rest period of 10 days to two weeks, a second series of injections is given.

Under any treatment shade and a plentiful water supply are indispensable to success. Early in the treatment, an 8-ounce dose of epsom salts is desirable. This should be followed by a 4-ounce dose daily for three days and, if needed, until the pyrexia subsides. Full therapeutic doses of ammonium carbonate twice daily are reported to be beneficial throughout the active stage of the disease.

7. *Prophylaxis.*—Infected ticks, of course, should be avoided. Picket lines and stables that have been used for infected animals within several weeks should be proscribed. Where such picket lines must be used they should be thoroughly cleaned, covered lightly with hay or straw, and burnt over. Freeing stables of ticks is accomplished only with extreme difficulty.

Where the disease is indigenous, the ticks should be removed from the horses several times daily. They are usually attached inside the concha, in or under the mane and around the dock and are difficult to locate. Small immature ticks (usually found about the dock) are as dangerous as the larger ones. The ticks collected should be burned.

Some success has attended the injection of 0.5cc of blood of young horses or burros that have recovered from the disease (carriers). The injection should be made in winter. The animal should then be placed in an infected pasture. The loss from this immunizing treatment, which simply amounts to inoculating the animal at the season most favorable to its recovery and at a time when it can be given the best care, averages about 3%.

Theiler recommended the inoculation of horses against *B. equi* with 1cc of blood from artificially infected asses after the fourth passage. The inoculation has been reported to cause no clinical reaction.

As is the case with piroplasmosis in cattle, horses that have recovered from an attack of the disease are immune so long as they remain in contact with infection. This tolerance of the organism can be broken down, however, by inadequate feed, overwork, exposure and other hardship.

LOUISIANA ARMY MANEUVERS, 1941

Horses being watered at the 30th Veterinary General Hospital at its camp on the Calcasieu River. Water was pumped from the river (by a gasoline motor) into canvas watering troughs to which the horses were led from the picket line four times daily. In this camp the number of animals averaged 300 and required the pumping of approximately 3000 gallons of water per day

Rinderpest

Edmonds

RINDERPEST IN BECHUANALAND PROTECTORATE: CATTLE SHOT AND DEAD FROM THE DISEASE
In one small valley 5,000 cattle were said to be lying similar to the above

1. *Synonyms.*—Bovine pest, cattle plague.

2. *Geographical Distribution.*—In nearly all of Asia, Ethiopia, Brazil, and many islands of the southwest Pacific, rinderpest is enzootic. Extensive outbreaks in Europe usually occur during wars in that area.

3. *Cause.*—A filterable virus.

4. *General.*—Throughout historical times rinderpest has been the most destructive disease of cattle. It occasionally affects other ruminants. It occurs in two forms, an epizootic, quiescent type that spreads slowly and from which most of the affected animals recover and an epizootic type which spreads with great rapidity, involves practically every bovine animal in its path and occasions a mortality approaching 100%.

For more than a thousand years rinderpest ravaged the cattle herds of Europe and, on various occasions during the great wars, completely destroyed the cattle industries of whole nations. This happened in Italy and also in Egypt late in the 19th Century. Within three years (1896-98) it swept through East and South Africa, from Somaliland to Cape Colony, destroying 97% of the cattle and most of the big game animals in Rhodesia. It is prone to assume the epizootic form under circumstances of war and to handicap seriously, a military force depending upon oxen for transport or cattle for food.

5. *Symptoms.*—The onset of rinderpest is signalized by a rise in temperature to about 105° F., increased pulse rate and staring coat. After three to five days characteristic symptoms appear; swelling and partial closing of the eyelids, epiphora and watery discharge from the nostrils. The discharge becomes thicker and more profuse, mucoid, then purulent in character. The inflammation of the nasal, oral and, in females, vaginal mucous membranes, becomes diphtheritic. Removal of the pseudo-membrane reveals large ulcers.

The appetite remains fairly good, until the mouth lesions develop. At which time the temperature falls to normal or below. As the course of the disease continues the animal becomes weak, the ears droop, the partially dried discharges hang in long strings from nose and mouth, and usually

death occurs in from 7 to 14 days. Animals that survive, begin to improve after two weeks and, except for the loss of flesh, the recovery is complete in three to four weeks.

6. *Treatment.*—No known drugs are of any value in the treatment of rinderpest.

ANTI-RINDERPEST VIRUS-SERUM VACCINATION IN INDIA

Antirinderpest serum definitely ameliorates the attack if given early. If given during the period of incubation, it prevents the disease.

7. *Prophylaxis.*—Rinderpest is so highly infectious that its control by quarantine offers great difficulty. However, prompt killing and burial of all infected and in-contact animals, quarantine against the movement of all ruminants and thorough disinfection of the area and of all articles that may have been contaminated by infected animals, serves to suppress an outbreak. These measures are more effective in rinderpest than in some other diseases, notably foot-and-mouth disease, since infection derives chiefly from the diseased animal and its products—hide, wool, milk, manure, etc., and infrequently through intermediate agencies—contaminated feed, corrals, water, attendants, etc.

When available, antirinderpest serum may be used either alone or with virus, on exposed or surrounding herds. The immunity from serum alone lasts 10 to 20 days; from serum and virus for the life of the animal. A disadvantage of the simultaneous vaccination is that the serum is often of low potency and reactions following serum-virus vaccination are likely to be severe; rather heavy losses being common.

The bile of affected animals may be used as a vaccine with fair prospects of reducing the loss. The bile should be collected only from cases that have survived seven days or longer from the onset of the disease. It must be obtained aseptically and without admixture of blood. The dose is from 20 to 100cc, given subcutaneously. From 10 to 20 animals can be protected from the bile of a single animal. By mixing the bile with one-half its volume of glycerine it may be preserved for weeks. This method of rinderpest control was employed on hundreds of thousands of animals in South Africa, and saved them. The bile vaccine method is now considered obsolete, but conditions might arise which would justify its use until better means could be employed. It possesses the advantage in an emergency, that the necessary material for the vaccination is always available on the spot.

Recently goat blood virus and goat tissue virus has come into wide use in India as a preventive of rinderpest in cattle. It is too early to form definite conclusions, but these vaccines of caprine origin give much promise of being a practical method of controlling the disease in cattle. It is less

successful in the carabao; the loss in this animal as a result of vaccination with goat virus sometimes reaches as much as 20%.

The development of goat blood and goat tissue vaccine has been proclaimed by the Indian Council of Agriculture to be the most important development in veterinary medicine since the beginning of the present century. The best results have attended its use simultaneously with a dose of anti-rinderpest serum.

The immunity from bile injections lasts for several weeks to several months. Immunity from goat-virus vaccination is long lasting.

No other method of rinderpest control has ever shown results comparable to those achieved in the Philippine Islands by the use of the tissue vaccine developed by Major (now Brigadier General) R. A. Kelser. This vaccine is readily prepared, keeps well, is safe to use and highly effective. With it rinderpest which had been a plague, seriously handicapping agriculture in the Islands as far back as their history extends, was completely eradicated in a period of about five years. The Kelser vaccine seems never to have been used extensively in India, through the ages, the happy hunting ground of rinderpest virus. Regardless of this fact American veterinarians will give the Kelser vaccine, if available, first place in any plans for rinderpest control. Its record is unassailable.

The Camel in War

No military campaigns in the Middle East, India or Somaliland have been able to dispense with the use of camels for transport, and commonly these animals have been used also for mounts. Perhaps the present highly-mechanized armies will not require them in any considerable numbers but again they may be necessary to maintain the flow of supplies to the fighting troops.

The principal communicable diseases of the camel—surra, rinderpest, anthrax, scabies, and foot-and-mouth disease—have been discussed elsewhere. Two other possible infections—barsati and styes (hordeolum)—should be mentioned. Common non-infectious ailments are cracked sole, tail sloughing and abscess in the pads on the sternum, elbow, stifle and knee.

In the purchase of camels for military use selection is far more important than is the case with horses, since camels possess little tolerance for changes in climate or conditions. Animals from the Nile Delta are useless on the desert or in the Middle East. Camels from hot districts cannot be used where it is cold nor can animals from the cool foothills stand the heat of India or Arabia.

The camel is of no military value until it is six years of age, and is not in prime until it is nine. It requires bulky food, 25 pounds of dry forage or 40 pounds of green forage daily. At hard work the camel requires also a supplement of grain but this must not be overdone. Five or six pounds of barley is the maximum. One pound of sugar daily is a valuable addition to the ration. It is customary to graze camels from 8:00 or 9:00 a.m. till 5:00 p.m.

Pack animals carry from 250 to 450 pounds, 20 miles daily. They should be watered once daily when water is available, but Indian camels can do with water every other day, Arab and desert camels every third day and Somali camels every fourth day. If these periods are extended the loss of condition is rapid and debility and total incapacity an early sequel.

Foot-and-Mouth Disease

Synonyms.—Hoof-and-mouth disease, aphthae epizootica, aphthous fever.

Foot-and-mouth disease is widespread throughout the world. North America experiences only occasional outbreaks. The disease is constantly present in Europe, Asia, and Africa but Australia is free from it.

This disease is quite apt to invade areas occupied by military forces and, owing to the interference with civilian veterinary sanitary services during a general mobilization, to prove uncontrollable. It is an obligation of the military veterinary service, to render to civilian authorities all assistance possible in prosecuting control measures.

Foot-and-mouth disease is due to a filterable virus, of which there are several types. It affects practically all cloven-hoofed animals. Different outbreaks may affect animals differently, thus, although in cattle mouth lesions usually predominate, there have been outbreaks in which lameness predominated. Owing to secondary infections many animals may lose their hoofs. In swine, foot involvement is prone to predominate. In the extensive outbreak of foot-and-mouth disease that occurred in Central Europe in 1937-1938, infection of the udder occurred in a majority of the cows affected. Approximately 25% of the dairy cows in Germany were ruined as milk producers. This resulted in an acute shortage of dairy products there in the summer of 1938.

The symptoms and treatment of the disease as encountered in war present no divergence from those ordinarily experienced in time of peace, and are well known to American veterinarians. The prevention and control of foot-and-mouth disease during war differ from the methods employed in peace time only because of the difficulties inherent in a depleted personnel for handling livestock sanitary police measures and the interference with quarantines which is inseparable from military occupation.

In Germany vaccination as a means of preventing foot-and-mouth disease is widely employed. Other countries have had little success with the vaccine. The failure to

Lesions of the hoof in foot-and-mouth disease

suppress the 1937-38 outbreak in Germany by the use of the vaccine was attributed to (1) the extreme infectivity of the disease in that outbreak causing a rapidity of spread theretofore unknown and (2) to the small amount of the vaccine available when the outbreak occurred; the vaccine having been developed only recently. In England and the United States the slaughter of affected and exposed animals is relied upon for eradication. Denmark relies upon vaccination, but like Germany was unready in 1938.

Foot-and-mouth disease can be readily introduced and disseminated maliciously, and can cause great disorganization and loss to the cattle industry of any country. It has therefore received considerable discussion in the veterinary press of our enemies as a possible agent of biological warfare. Among its adaptabilities for the purposes of sabotage are: (1) The virus is tenacious of life, (2) it spreads with extreme rapidity, (3) cattle, sheep, goats, swine and even wild deer are susceptible, (4) it can be spread from market centers to break out simultaneously over hundreds of thousands of square miles, (5) it so closely resembles two other stomatites as to easily escape recognition until the epizootic has gained great headway, (6) it depletes rapidly the food supply (meat and dairy products) and wealth of the area it invades and (7) it disorganizes the marketing of food animals.

Infectious Encephalomyelitis

1. *Synonyms.*—Mad staggers, blind staggers, stomach staggers, sleeping sickness, cerebritis, horse plague. In man: Encephalitis, sleeping sickness.

2. *Geographical Distribution.* — Probably world-wide.

3. *Cause.*—A neurotropic virus or viruses.

4. *General.*—In the control of encephalomyelitis among army animals the veterinary officer has a responsibility not only for conserving the animal strength of the command but for protecting the military personnel from a possible source of infection of serious import. It is true the army veterinary service has a similar responsibility in the control of some other diseases of animals—anthrax and rabies, for example. But in the matter of encephalomyelitis the responsibility may be greater for, whereas the mortality in persons from rabies in the United States averages fewer than a hundred annually, the same virus that causes encephalomyelitis in horses was responsible for a greater number of deaths of persons in a single state in 1941.

There are three types of encephalitis in man—lethargic encephalitis or sleeping sickness; St. Louis encephalitis, and the equine type encephalitis. All are new diseases or, at least, diseases that have been recognized only recently. Lethargic encephalitis was first recognized during the winter of 1916-17. It was a serious disease among soldiers in Europe during World War I. It appeared in this country in the winter of 1918 and every winter for a decade cases occurred in the United States. This type occurs only in cold weather and is not known to affect horses. The cause of lethargic encephalitis has not been determined.

St. Louis encephalitis was first recognized in 1932. Severe outbreaks occurred in St. Louis, Missouri, in the summer of 1933 and 1937 with sporadic cases in various parts of the country in between those years and since. It is due to a virus to which horses are susceptible. It is a summer disease.

Equine type encephalitis in man, also a summer disease, was first supected by Karl Meyer in 1932, when he saw two cases. Both victims had been closely associated with horses suffering from encephalomyelitis. However, Meyer had no opportunity to prove that the equine virus was responsible for the ailment. In 1937 six cases in man occurred in Minnesota and several cases were reported unofficially from Manitoba. In 1939 and 1940 the incidence was but little higher. In 1941, this country experienced the most extensive outbreak of encephalitis in its history—4000 cases with 450 deaths in the plains section from Colorado to Saskatchewan. In North Dakota, there were 1080 cases and 104 deaths, in Minnesota 851 cases and 65 deaths. Had the same incidence rate, that occurred in North Dakota, prevailed over the whole of the United States there would have ben 230,000 cases in man and, had the average mortality obtained, there would have been 25,000 deaths.

Clinically, St. Louis encephalitis and the equine type of the disease are indistinguishable in man. In horses St. Louis encephalitis is believed to be usually subclinical, from natural infection. However, from intracerebral inoculation the disease resembles encephalomyelitis and may be fatal. The death rate in persons from the western equine type virus averages 11% and from the eastern type 73%. In the horses, mortality from each type of the equine virus is considerably higher. Fortunately, there have been relatively few cases caused by the eastern strain of virus in either man or horses.

There is some evidence that the horse is the source of the equine type of encephalitis infection in man but a great deal more that it is not. However, the question is not settled and, until the facts are known, the army veterinary service can relax no efforts to afford military animals complete protection from the disease; as the experience of 1941 has shown, the equine type of the virus may constitute a grave potential hazard for the military personnel. Federal regulations require that all laboratory employees engaged in the manufac-

ture of encephalomyelitis vaccine be immunized against the disease.

The information extant on neurotropic viruses is nearly all of recent development and is being added to rapidly by research. Some conceptions held at the present may have to be revised in the near future.

Neurotropic virus diseases of horses occur in most countries. They possess many clinical similarities but exhibit antigenic difference, different mortality rates and perhaps some other characteristics peculiar to each type of virus. The two types occurring in North America, Borna disease of Central Europe, a type in France, two types in India and one in the Northern nations of South America, seem to be due to seven different, but related, strains of neurotropic virus. However, some regard the virus of Borna's disease as being unrelated to the others.

Encephalomyelitis of horses is by no means a new disease. The origin of the terms "mad staggers" and "blind staggers" is lost in antiquity. In India mention of such diseases antedate the Christian era.

Throughout the long record of such diseases they have occurred in waves—epizootics. This feature was largely responsible for calling them "forage poisoning." It afforded an explanation for widespread outbreaks when infection could not be incriminated.

Another reason for confusion as to the etiological factor is the existence in North America, and perhaps elsewhere, of a disease identical to the virus disease clinically, but believed to be dietary in origin—a toxic encephalomyelitis. This conception may have to be revised but it appears, at the present time, to be well founded. Climatic conditions that result in widespread production of feed of poor quality are precisely those which favor the multiplication of the insects which are regarded as the transmitters of the infectious type of the disease. Hence, waves of both toxic and infectious forms of encephalitis tend to be superimposed one upon the other.

Some matters concerning the infectious type of encephalomyelitis are not yet generally agreed upon. By many the incidence of the disease in outbreaks is thought to be not over 10% of the horses and mules in the district. Others regard the incidence as being much higher but that only a minority of the animals affected display nervous symptoms. In an experiment in temperature recording, during an outbreak in India, it was noted that a transient pyrexia preceded the nervous symptoms of the disease in all instances. This had been noted previously. However, in the Indian experiment, a larger number of animals presented an identical pyrexia but no other symptoms. This led to the postulation that these latter animals also suffered an attack of the disease but did not develop the nervous symptoms. The view, that the subclinical attacks of the St. Louis type of human encephalitis and of anterior poliomyelitis (also due to a neurotropic virus) are far more common than clinical cases, has a considerable number of adherents in the medical profession.

"Equine" as a part of the name of infectious encephalomyelitis is a misnomer, since a long list of mammals including man, and several species of birds, are susceptible to the disease. A number of them, including man, suffer from natural infection. In fact, as has already been indicated, infectious encephalomyelitis may be, next to the plague and typhus, the most important infection common to both man and animals.

As previously stated two types of the disease occur in the United States—eastern and western. The case mortality among horses in outbreaks of the eastern type is about 90%; in the western type rather less than 25%.

Cases reported to the federal Bureau of Animal Industry numbered approximately 23,000 in 1935; 4,000 in 1936; 176,000 in 1937; 185,000 in 1938; 9,800 in 1939; 17,000 in 1940; and 37,000 in 1941. As yet the eastern type of the disease has occurred only east of the Appalachian Mountains and along the Gulf Coast.[1] The western type has occurred widely in all of the states west of the Appalachian Mountains and in the prairie provinces of Canada.

[1] During September, 1942, approximately 200 cases of encephalomyelitis occurred in Calhoun County, Michigan. At this writing the type of virus has not been determined, but the mortality was 100%, which arouses the suspicion that it may have been the eastern type.

The manner in which the disease is communicated from animal to animal is perhaps not fully understood. Ten species of mosquito, all Aedes, have been shown to be capable of transmitting encephalomyelitis and recently naturally infected mosquitoes (*Culex tarsalis*) have been found. One species of tick also is known to have transmitted the virus to a susceptible animal. However, the epizootiology of the disease and the distribution of the cases strongly indicate that the mosquito is the principal vector. How the virus lives from one season to next and then spreads over thousands of square miles of territory almost simultaneously is as yet unexplained. However, a large number of species of animals and birds have been shown to be capable of constituting a reservoir of the infection. The evidence inclines toward migratory birds as the natural reservoir but positive incrimination is lacking.

Infection with the western virus is more certain by the bite of a mosquito than by injection. Subcutaneous injection of this virus is only occasionally ineffective; but bites of infected mosquito invariably infect, and the symptoms develop more quickly than when infection is by artificial means. It is not known why this should be the case. Possibly some change in the virus may occur in the mosquito to make the infection more virulent; or the accompanying salivary secretion may enhance its growth.

In 1938, there were, as has been stated, 185,000 cases of equine encephalomyelitis among civilian-owned horses. About 40 cases occurred in army animals. Chick vaccine was used on approximately 3,500 military animals that year. In 1939, all army animals, about 35,000 were vaccinated. In 1940 again, some 35,000 were vaccinated, the dose being 10cc subcutaneously, repeated in one week. In 1941, approximately 50,000 were vaccinated, 1cc being given intradermally, and repeated a week later. All army animals are now given two intradermal doses of bivalent vaccine annually. To date the Veterinary Corps of the Army has administered approximately 123,000 double doses of prophylactic treatments of chick tissue vaccine. There have been no cases of encephalomyelitis among army animals that were properly vaccinated.

5. *Symptoms.*—The principal symptoms of infectious encephalomyelitis are those of mental derangement, restlessness, and paralysis. The virus type cannot be distinguished clinically from what is regarded as the toxic type of the disease, which is thought to be due to damaged feed.

The onset of the symptoms is sudden. The temperature ranges up to 107° F., the gait is uncertain, the movements aimless. There may be stupor from the beginning, or the case may begin with nervousness and excitement, even delirium, the animal pushing with head or breast into anything it can get against, or walking constantly in a circle, or running into objects blindly. The appetite is in complete abeyance and constipation is marked and stubborn. Partial paralysis of the hind quarters is an early symptom. It soon affects the throat and in most cases progresses until it affects practically all voluntary muscles. It is apt to develop unequally in opposing groups of muscles and cause distortion—such as pulling the muzzle to one side or causing the lower lip to droop. The inability to swallow, even saliva, causes the mouth to give off a foul odor. Paralysis of the muscles of the bladder and rectum is common.

6. *Treatment.*—The treatment of encephalomyelitis is mainly symptomatic. Combat the dehydration, which speedily becomes acute, with intravenous or intraperitoneal saline injections. Water, to which gruel and sugar have been added, may be given *via* the stomach tube, if it does not distress the patient too greatly. Relieve the obstipation and employ general supportive measures. Infected animals should not be worked; their chances of recovery are materially lessened, even by exercise.

Th temperature of all animals should be taken at least twice daily during an outbreak of the disease. Any that show an elevation of temperature above normal should be hospitalized and supported by a well-padded framework as soon as any other symptoms of the disease appear. The mortality has been reduced to less than 10% where this plan has been followed.

Nursing is more important than medication. Do not disturb excitable cases; support in harness, or in a frame, those cases that have difficulty in standing and in every way contribute to the comfort of the animal; provide shade, protection from flies, etc. Since the animals are usually unable to drink, water should be given *via* the stomach tube if the animal is in a suitable condition; otherwise, give copious rectal injections.

Army horses are now vaccinated against both eastern and western strains of infectious encephalomyelitis getting 1cc of each vaccine (mixed), two cc's of vaccine if deposited properly *in* and not under the skin raises a welt of half the size of an English walnut. Up to 1942 army veterinarians had vaccinated 123,500 animals without an unfavorable reaction of the disease in a vaccinated animal

In intradermal vaccination with encephalomyelitis chick vaccine restraint is important. Some animals require more vigorous measures than the one shown in the illustration. The desideratum is to deposit the vaccine into and not under the skin—intradermal not subcutaneous injection. Unless restraint is good, time is lost and the danger of depositing the vaccine subcutaneously is increased

Given early in attacks that are not peracute, antiserum possesses some value. It is probably useless to administer less than 2000cc and the expense makes it impractical, except for horses of unusual value.

7. *Prophylaxis.*—The chick embryo vaccine is remarkably efficacious as a preventive of encephalomyelitis, i.e.. provided the right type of vaccine is used. It is preventive only for the type from which it is made. Western strain vaccine is ineffective against eastern strain virus and vice versa. (The same applies to Borna disease virus and the French type virus.) Two doses should be given intradermally, 7 to 10 days apart.

All army animals in this country are routinely vaccinated against both the eastern and western types of encephalomyelitis but there is a possibility that were they taken with an expeditionary force, they might be exposed to a type of virus against which they had not been immunized. In such cases the following prophylactic measures are recommended:

a. Make liberal use of fly and mosquito repellants.

b. Keep the animals in screened stables at night.

c. Protect the animals in the day time with fly nets or burlap coverings.

d. Permit no grazing; keep the animals stabled when not working.

e. Keep the animals moving when out of the stable; permit no riding in or near brush or tall weeds and grass.

f. Burn damp straw or use smudge pots about watering places and picket lines, if they must be used.

g. Inspect the animals and take temperatures twice daily during an outbreak of the disease in order to detect cases early. Do not work or exercise animals showing an elevation of temperature. Hospitalize them immediately.

h. Keep infected animals in screened, darkened enclosures. Since some species of Aedes will fly as far as 30 miles, isolation is not sufficient.

Equine Infectious Anemia

1. *Synonym.*—Swamp Fever.

2. *Cause.*—A filterable virus.

3. *Geographical Distribution* — World-wide.

4. *General.*—This disease has been discussed in veterinary literature for a hundred years but most of the known facts concerning it have been developed since 1904. During World War I it occasioned extensive losses in all armies in Europe, and still heavier losses among horses belonging to civilian populations on that continent.

Equine infectious anemia has been recognized in the United States since 1911. In this country it has occurred widely, in cycles of considerable prevalence, over the Missouri Valley and southward and in the Mississippi River delta, in contrast to its occurrence in Europe which has usually been in low lying districts or on marshy farms. It is much dreaded by informed livestock owners because of the difficulty of diagnosis, its high mortality and its resistance to treatment.

Only solipeds are susceptible to infectious anemia by natural inoculation. The usual means of its transmission from animal to animal is unknown, but biting insects are strongly suspected. It can be transmitted by ingestion but a relatively large amount of the virus is necessary to infect by this route. Stein and Mott[1] have shown that it may be transmitted from an infected stallion to a susceptible mare through coition but is not spread in the reverse direction, i.e., from an infected mare to the stallion. Its transmission from dam to offspring both *in utero* and during the suckling period occurs but is not common.

The disease may be transmitted by the inoculation of infinitesimal quantities of infectious blood. An amount sufficient to barely stain a hypodermic needle may convey the disease when the needle is used on a susceptible animal. This points to a very real danger to army animals when they are given the mallein test or vaccinated. The blood of an infected horse retains its infectivity for a long period, possibly for the life of the animal.

5. *Symptoms.* — Infectious anemia occurs in acute, chronic and latent forms and in carriers also. The symptoms of the acute and chronic forms bear little resemblance to one another. There are no clinical manifestations of the latent form, until exacerbations occur after which it usually becomes a chronic case. Carriers may be detected only by the spread of the disease to animals associated with them and therefore are usually suspected rather than definitely proved carriers. Laboratory tests are inconclusive in the equine species either for infected animals or for carriers.

Acute Infectious Anemia: In acute attacks the symptoms are essentially those of septicemia. High temperature, usually about 104 sometimes up to 107°F., rapid pulse, hurried respiration, pronounced depression, stubborn disinclination to move and when forced to move dragging the toes of the hind feet are common in acute attacks. It is differentiated from respiratory disease by the absence of catarrhal symptoms (although there may be a thin nasal discharge) and a more uncertain and staggery gait. The affected animal tires more easily than from almost any other ailment. The appetite may be in abeyance, impaired or unaffected; rather commonly the latter. The visible mucous membranes are muddy and the conjunctivae may be swollen. In colts and stallions a frequent erection of the penis may occur, this symptom may have some pathognomonic significance. The attack lasts 10 to 15 days and is highly fatal (50 to 70%). If apparent recovery takes place, relapses occur when the animal is put back to hard work. The spread is slow. Additional cases in the same stable seldom occurring in a less period than a month although they may occur as early as eight days. Diagnosis is arrived at, in part by exclusion.

Chronic Infectious Anemia: The chronic type of infectious equine anemia is characterized by recurring subacute attacks less

[1] Stein, C. D., and L. O. Mott, 1942. Studies on congenital transmission of equine infectious anemia. *Vet. Med.* 37:9; pp. 370-377.

severe than those of the acute type with intervals of remission. The temperature ranges from 102 to 103° F. and is often higher in the morning than in the evening. This inverted daily temperature curve is of considerable diagnostic value. The recidivations may occur as often as twice monthly or at longer periods up to three, and even eight months. They can be precipitated at any time by hardship and may be postponed by rest, good care and good feeding.

In time the animal becomes progressively weaker and emaciated in spite of a voracious appetite and good feed. It tires easily and, in the later stages of the disease, is unable to work at all. The pulse is quickened and the heart action is pounding. Anemia becomes extreme and the blood requires an hour or longer to clot. On sedimentation the erythrocyte volume is only one-third or even one-fourth that of normal. The red blood cell count falls to two million or even to 1,500,000. The picture is one of cachexia. Death is the almost invariable outcome.

6. *Lesions.* — The necropsy findings in acute attacks of infectious anemia are not characteristic. They are extremely variable and may resemble those of anthrax or piroplasmosis or almost any acute septicemia. Great enlargement of the liver and spleen is perhaps the most distinguishing macroscopic lesion but it is not always present.

In the chronic type of the disease few lesions are revealed on necropsy other than those of any severe chronic anemia. That anemia is so advanced and severe without other observable cause is, in itself, a diagnostic factor. The fat is usually a deep yellow; the blood thin and slow to clot; the proportion of cells to serum ranges from 1:4 to 1:8; the red bone marrow is increased in amount; the heart enlarged and the walls thin and flabby. There is slight petechiae on the kidneys and to a less extent in other tissues; the liver is light colored. The spleen may or may not be somewhat enlarged; emaciation is extreme.

7. *Treatment.*—No treatment of curative value is known. Army regulations provide that infected animals be destroyed as soon as detected. In civilian practice arsenicals and various other "tonics" are sometimes

employed. If the animal survives the acute attack, almost any line of treatment is apparently successful—if it includes good feed and complete rest. But the attack recurs, usually in the chronic form, when the animal goes back to work; perhaps in possession of a new owner.

8. *Prophylaxis.*—Since the means of transmission of equine infectious anemia are not fully known and since no method of immunizing the susceptible animal is available, prevention resolves itself into the avoidance of association of infected and susceptible animals. This makes the problem one of early diagnosis and immediate disposal of infected animals. However, since early diagnosis is extremely difficult in many cases, every means that might inadvertently spread the disease should be avoided routinely. An example of such means is the use of the same needle in mallein testing on two or more horses without thorough disinfection after its use on each animal, or a similar practice when vaccinating the animals of a command against encephalomyelitis, tetanus, anthrax or other infection as previously mentioned. The veterinarian must not forget that minute quantities of the blood of an infected animal may convey the disease to a susceptible one by inoculation. As a precautionary measure it may be well, in the presence of an outbreak, not to change harness, saddle, bridle or halter from one animal to another, as it may be possible to inoculate animals through abrasions made by them.

Infectious Stomatitis

1. *Synonyms.*—Contagious stomatitis, vesicular stomatitis.

2. *Geographical Distribution.* — Worldwide.

3. *Cause.*—A filterable virus or filterable viruses.

4. *General.*—Outbreaks of stomatitis are of frequent occurrence in military animals in time of war, when large numbers are agglomerated.

Catarrhal stomatitis, that due to mechanical injuries, irritant chemicals or acrid forage, seems not to have attracted sufficient attention to have been reported as occurring in military animals. Aphthous or mycotic stomatitis, the type due to molds, and phlegmonous stomatitis may be considered of minor importance to the veterinary officer. Pustular stomatitis (horse pox) is a benign disease, from which spontaneous recovery occurs in about three weeks and, judging from reports, is not common among military animals.

Infectious stomatitis, however, occurs in extensive epizootics—running through all the animals of even large commands within a period of a few weeks and affecting approximately 50% of the horses. There were more than 9,000 horses in the Third Army during the Louisiana maneuvers in 1941. These animals were distributed over hundreds of square miles of terrain with little intercourse between the animals of different organizations, yet as many as 500 new cases of stomatitis occurred daily near the end of the maneuvers. They were not evacuated because of the disease.

The disease is due to a virus of which there appears to be two varieties or types or perhaps the two types of the disease may be due to different viruses. One form, designated vesicular stomatitis, is characterized by fleeting, thin-walled vesicles on the tongue and other oral mucous membranes and some rather mild constitutional symptoms. It was prevalent during World War I, particularly among horses purchased in this country for the French Army. The other form of the disease, the one encountered in the Louisiana army maneuvers in the summer of 1941 differed in that there was an almost entire absence of vesicles; the muzzle, in addition to the oral mucous membranes, was frequently involved and there were no constitutional symptoms.

In both types of the disease the course is rapid and the mortality due to the disease *per se* is nil. The vesicular type, however, results in loss of condition. Both types interfere with use of the animals.

5. *Symptoms.—a. Vesicular type.* The disease is ushered in by slight dullness, impaired appetite and usually some elevation of temperature. As the disease progresses, red areas appear on the tongue, salivation occurs and within a few hours thin-walled, bladder-like vesicles (½ to 2 inches in diameter) form at the site of the inflamed areas. They may extend and coalesce until practically the whole area of the tongue is covered and some may appear on the buccal surface of the mouth and inside the lips. Within 12 to 24 hours the vesicles rupture, leaving superficial, purplish, granulating ulcers which heal spontaneously in 10 days to two weeks. Only the epithelium is raised in the blister or exfoliated. The denuded surface is bluish-red in color, bleeds easily and is very sensitive. There is considerable salivation of a ropy nature often tinged with blood. Eating is painful and the animal refrains from it—hence, the loss of condition. Two types of vesicular stomatitis (Indiana and New Jersey) have been described.

b. Nonvesicular type.—In the other type of infectious stomatitis (the type seen in the Louisiana maneuvers) vesicles are rarely seen. There is no observable constitutional effect produced on the animal, even though the lesions are extensive. There is no elevation of temperature, malaise, nor loss of appetite. There is little salivation, and that only in advanced stages of the disease. The denuded surface is bright-red. In rare cases a single vesicle may be observed. Such vesicles, when they do occur, persist for only an hour or two.

The first abnormality noted is the ab-

sence of mucous membrane on areas of the tongue. These are usually few in number, and ½ to 1 inch in diameter; the mucosa and sub-mucosa being eroded down to the muscles. There is no evidence of inflammation surrounding the denuded areas. Nevertheless, these areas enlarge rapidly until, in most instances, the entire surface of the tongue is denuded and the muscles may be seen through a transparent, glistening coagulum or adventitious membrane. To a less extent the buccal surface and the inner surfaces of the lips are similarly affected. In about 10% of the cases a few and sometimes many lesions appear on the muzzle. They are most plentiful near the junction of the mucous membrane and the skin but extend to the nostrils and rarely to portions of the mandible covered with hair.

Strangely, even when the tongue is completely denuded of its mucous membrane the animal offers no objection to the handling of it and eats such rough forage as oats and hay readily and but slightly more slowly than normally. Regeneration of the mucous membrane begins four to five days after exfoliation is complete. At first, scattered centers of regeneration may be observed which are barely visible to the naked eye. These increase in number and size till the whole surface is covered. The process requires about three weeks. The whole course of the disease is about 30 to 32 days.

6. *Treatment.*—None of the ordinary mouth lotions or antiseptics exert any influence on the progress of the disease. In a limited number of cases in the outbreak during the Louisiana maneuvers, an aqueous solution of carbol fuchsin, applied to the denuded areas frequently, seemed to slow down their rate of enlargement so that not all of the dorsal surface of the tongue was denuded. The period of healing, however, did not appear to have been shortened. Certainly no treatment tried was worth the trouble of administering it.

7. *Prophylaxis.*—No quarantine, segregation nor isolation of affected or well animals, had any influence on the extension of the type of the disease seen on maneuvers. Many horses, apparently about 50%, appeared to possess a resistance to infectious stomatitis and did not develop it even when fed and watered with the infected animals. Attempts to inoculate animals, not naturally infected during the outbreak, failed completely in a limited number of cases.

Numerous scrapings (collected under the mucous membrane near the margin of denuded areas) uniformly revealed, on microscopic examination, a short chain streptococcus; sometimes in pure or nearly pure culture. The contents of one vesicle gave a pure culture of the same organism. The organism grew readily on artificial media. Repeated efforts to inoculate animals with the culture and produce the disease were unsuccessful. Despite the constant presence of this streptococcus it is not thought to have primary etiological significance.

LUNCH ON THE DESERT—30TH VETERINARY GENERAL HOSPITAL, 1941

African Horse-Sickness

1. *Synonyms.*—Horse pest, perdeziekte.

2. *Geographical Distribution.* — Tropical Africa.

3. *Cause.*—A filterable virus.

4. *General.* — Horse-sickness has been known in Africa for 250 years. It occurs from about 20 degrees North to 35 degrees South Latitude. In low swampy areas it may occur all the year, elsewhere it is unknown during the dry season but begins to appear about three weeks after the rainy season starts. In localities where frost occurs, epizootics end abruptly, eight days after the first frost.

African horse-sickness varies much in prevalence and severity from season to season. In some outbreaks it has attained an incidence of 100% and a mortality rate of 100% over considerable areas, i.e., every horse, mule and ass in the district has succumbed. In an outbreak in 1913-14, 90% of all the horses in Rhodesia died of it. The disease is always destructive to animals newly brought into horse-sickness districts and has wrought disaster to more than one military expedition.

All solipeds, including zebras and zebroids, are susceptible to natural infection by horse-sickness, and to artificial inoculation with minute amounts of infective blood. Dogs acquire the disease by eating carcasses of animals that have died of it; cattle, goats and most laboratory animals are susceptible to artificial inoculation.

Although horse-sickness has been studied by various distinguished investigators including M'Fadyean, Koch, Thieler, duToit and others, the agency responsible for its transmission from animal to animal has not been determined. By circumstantial evidence, it is known to be communicated by night-flying, biting insects, and it has been shown that certain mosquitoes are capable of carrying it, but whether in nature the mosquito is the sole, or even the principal vector, is unknown.

5. *Symptoms.* — Horse-sickness occurs in two forms: (1) An acute pulmonary form in which most of the animals affected die in from an hour to several days and (2) a subacute cardiac form in which the symptoms, similar to those of the acute form develop more slowly and the course may run up to several weeks.

The onset is characterized by a high temperature (104 to 107°F.) with rapid, small pulse and hurried, labored respiration. Edema occurs early or later in the attack; if in the lungs, it may terminate suddenly in death. In the subacute cases edema of the head and neck is pronounced, usually beginning in the orbital fossae which are first filled level with the surrounding tissue and may later be surmounted by swellings of the size of an egg giving the animal a peculiar appearance. The head becomes enormous as the edema increases and gradually extends to the trunk and limbs. When improvement begins the edema first recedes from the head. When edema involves the lungs seriously the animal stretches out on its side and a large amount of white or yellowish, foamy exudate is discharged from the nostrils. Such cases are usually fatal. Animals that recover are subject for several weeks to relapse, if worked.

6. *Lesions.* — Of postmortem lesions Edmonds says:

"Frequently there will be a quantity of white or yellowish-white froth, exuded from the nostrils, lying in front of the nose, coupled with the swellings about the eyes, and in the 'dikkop' (thick head) form of the disease the enlargement of the head and neck presents a typical picture of the animal that has died of horse-sickness. These appearances should not be accepted as absolutely diagnostic of horse-sickness, although they often are. The most constant and reliable lesion is an intense injection of the villous-portion of the stomach. There is nothing like the intense, dark redness and absence of inflammatory signs in any other disease that I have seen, not even in arsenical poisoning. The intestines, large and small, frequently present a similar streaky injected appearance. The next most constant lesion is found in the lungs and heart. The lungs are infiltrated with amber-colored serosity, and on cutting into them this and froth exudes from the cut surfaces. In cases where the froth has not exuded from the nostrils the smaller and larger bronchial tubes will be found filled with it. The heart shows hemorrhage blotchings of a mulberry color; the heart sac contains a quantity, often a large

quantity, of clear fluid, and the chest the same type of fluid in larger amount. The other organs and portions of the body are usually normal in appearance."

7. *Treatment.*—No medicinal treatment has proved of value. Naturally where the most critical involvement is edema of the lungs, all work and exercise must be pro-

Edmonds

Horse-Sickness, Dikkop (thick head) Type, showing typical nasal effusion—from Edmond's "Diseases of Animals in South Africa"

hibited and the animal kept as quiet and as comfortable as possible (protected from flies). Edmonds states:

"The only treatment from which I have seen good results is withholding drinking water whilst the acute symptoms are present, and afterwards allowing it only in very meagre quantities, such as a pint at a time. I have seen animals so treated live several days and show every indication of recovering; but upon giving them a bucket of water they have died within an hour."

8. *Prophylaxis.*—Prevention of horse-sickness consists in protecting the animals from night-flying insects during the season of infectivity. This can be accomplished for farm horses by stabling at night in screened stables; a procedure that is seldom practical for military animals. For the latter certain practices may be instituted that afford a large measure of protection.

1. Do not permit horses or mules to go near swamps or low lying water holes at night at any season.

2. During the rainy season protect animals from insects from an hour before sunset till an hour after sunrise by smoke or fly repellant ointments. Sulphur ointment is said to afford complete protection.

Theiler in 1905 developed a virus-serum inoculation for mules from which the loss was only about 5%. Later he extended its use to horses. The loss in these animals rose to 10%, but even so it proved sound commercially. Unfortunately equine infectious anemia is so prevalent in South Africa that the animals that were treated were often inoculated with the latter disease and the method fell into disuse on that account. Later the simultaneous vaccination somewhat modified was revived by Bevan with better prospects of success.

Blue Tongue
(Malarial Catarrhal Fever)

A filterable virus disease of sheep very similar to horse-sickness in history, incidence, onset and symptoms occur in the same regions. It is, however, less acute and the mortality rate is lower (5 to 50%). Sheep are readily immunized by inoculation with an attenuated virus. Treatment of affected animals is regarded as not only futile but harmful. Sheep which have recovered are immune against further infection, but their blood sometimes remains virulent for 50 days.

Ephemeral Fever

A filterable virus disease of cattle locally known as "three day sickness" occurs widely over Africa. Like horse-sickness and blue tongue it occurs only during the rainy season except in low-lying swampy areas where it may occur at any season. It too, is thought to be transmitted by biting insects. An outbreak of the disease in a herd is spectacular since up to 50% of the animals are attacked simultaneously. Most of them go down and are unable to arise. There is swelling of the joints and great muscular pain. The mortality is almost nil. The animals recover in from two days to two weeks, most of them on the third day of the attack. Treatment is of no avail and should not be attempted. The disease is communicable readily by blood inoculations.

The incubation in such cases is also three days.

Glanders

1. *Synonym.*—Farcy.

2. *Geographical Distribution.*—Asia, Europe, Africa, South America, and to a slight extent North America.

3. *Cause.—Bacillus mallei.*

4. *General.*—In all armies in all ages to the first decade of the present century, glanders was the number one scourge of army animals and only a little less serious in the havoc it wrought among solipeds of the civil population.

Glanders was known and described (by Vegetius) nearly 2,500 years ago. It was recognized as a contagious disease as long as 1.500 years ago. This recognition of its contagiousness enabled horse owners to hold it somewhat in check, except during war, when it invariably wrought havoc among the agglomerated animals of armies and spread from them to the horses of the civil population. About 1750, strict sanitary police regulations for the control of glanders were adopted in France.

Where glanders is prevalent among the horses, rare cases occur in man. There are reports of large numbers of cases having occurred among persons, principally children, of Eastern Europe, following World War I but the reports lack authentication. These human cases of the disease are supposed to have been acquired by eating the flesh of glandered animals. Charles Vial, founder of the London Veterinary College, in 1791, died two years later from this disease. At least one American veterinarian was a victim of it since the turn of the century.

Glanders was a rare disease in the United States until the Civil War. Veterinarians who had the advantage of formal training in veterinary medicine were few in this country at that time and even the few were not employed by the army. As a consequence, glanders ran wild and was soon the cause of enormous loss of army animals. Matters were made still worse by the selling of army horses at public auction when they were unfit for further army use.

The disease was soon present everywhere east of the Mississippi River. Probably no township and certainly no county escaped the infection then or later. Within a decade, after the end of the Civil War, glanders became the No. 1 animal disease problem of the country, causing the farming and transportation industries a staggering loss and requiring 50 years to bring under control.

When the Spanish-American War began in 1898, there was a total of 40 veterinarians with the cavalry and artillery regiments. This number was augmented slightly for the army by a few in national guard organizations and a few who were hired by the Quartermaster. Their status was essentially that of civilians and they lacked the authority or prestige necessary to carry out disease control projects or to initiate disease prevention measures. The glanders situation among army animals was handled only a little better than it was during the Civil War. It was only by resorting to the federal court that the sale of infected animals to the public was prevented. The matter was finally placed in the hands of the Federal Bureau of Animal Industry and thereafter no infected animals were distributed to the public. This placed the mallein test on a solid basis and gave it universal recognition. Glanders was on the way out in this country and a score of years saw it nearing elimination.

The development of the mallein test has made glanders easy of control. Since World War I it has become practically unknown in this country but it still exists in many countries and is practically certain to spread from civilian to military animals when armies occupy such areas. Veterinary officers must be ever on the alert to detect cases at the earliest possible moment by frequent mallein tests of all animals in the command. Despite all that was known about it during World War I the French Army lost 58,000 horses from glanders.

Glanders is primarily a disease of the lungs but has a tendency to localize also in the nasal mucous membrane and in the skin. Involvement is usually chronic and presents no characteristic symptoms until it is far advanced. With good feeding and

proper care a large percentage of cases, where only the lungs are involved, recover. Many such recovered cases remain carriers for life and a menace to any other of the equine species with which they may be associated.

In the horse, glanders is usually a chronic ailment, in the ass it is nearly always acute. The mule occupies an intermediate place in susceptibility. However, both horses and mules subjected to the hardships of a military campaign may suffer principally from the acute form. Infection is mainly by ingestion and the public or common watering trough, hay rack or feed box is the usual source of infection.

5. *Symptoms.*—Clinical symptoms of glanders should not often occur in army animals. If the mallein test is applied at sufficiently short intervals where danger of infection exists, the disease should be detected before clinical symptoms develop. They may, of course, occur in civilian owned animals in the area occupied by the military forces. The symptoms differ with the location of the disease—whether in the lungs, nasal mucous membrane, or skin (farcy).

a. Pulmonary type.—This form, usually termed latent or occult glanders, may exist for months before any clinical symptoms are manifest and when they appear the symptoms are not characteristic—loss of condition, staring coat, asthenic, unproductive cough. As the pathological process continues, blood stained mucous is coughed up. The hide appears to adhere to the ribs (hide bound) and localization in the nasal mucous membranes is prone to ensue with attendant symptoms.

b. Nasal glanders.—This type, like the pulmonary type, may be very chronic and exist for a long period in the upper portions of the Schneiderian membrane where the lesions cannot be seen except on necropsy and the only nasal indications of the presence of the disease may be a slight serous discharge, often intermittent, from one or both nostrils. As the disease process continues, the discharges becomes mucoid in character, and finally purulent, often streaked with blood. It adheres tenaciously to the alae. It may be thrown out in large quantities by coughing and snorting. The inflammatory process extends and finally may reach the external openings of the nostrils.

A disagreeable task of the veterinary officer during World War I was holding necropsies on reactors to the mallein test—*Veterinary Military History*

When visible portions of the nasal mucous membrane are attacked the symptoms in the beginning are indistinguishable from any other nasal catarrh. Later small nodules covered by glistening epithelium develop, break down, and form minute ragged-edged ulcers which coalesce rapidly to form large deep ulcers with abrupt irregular edges. At this stage a persistent nose bleed, when the animal is worked, is a common and almost pathognumonic symptom. Some of the ulcers may heal to form irregular (star shaped) cicatrices.

Any infection of the nasal mucous membrane is accompanied by inflammation of the submaxillary lymph glands. The inflammation of these glands due to glanders is of a peculiar type and highly significant. There is not a tendency for the glands to break down and suppurate, as for example in strangles. Early in the disease they are enlarged, painful and movable but they soon shrink, become very dense and knotty and are attached securely to the surrounding tissue and bone. In this condition the gland is not sensitive to pressure. The

glands on both sides are involved when the nasal infection is bilateral; only on the same side as the infection when it is unilateral. It is commonly bilateral.

c. Cutaneous type (farcy).—This type commonly attacks the lymph glands of the legs, less frequently the sides of the thorax and inferior surface of the abdomen. Nodes of the size of a pea develop in the skin and may terminate in abscesses of the size of a walnut. They are usually quite sensitive. The inflamed glands break down and discharge a viscid yellowish, gray pus through a small opening. The ulcers enlarge and deepen and become indolent. Sometimes the subcutaneous, connective tissue proliferates until the legs attain an enormous size.

d. Necropsy.—Army Regulations require a postmortem examination of the carcasses of all animals destroyed because of a positive reaction to the mallein test. At the necropsy, particular attention should be centered on three organs,—the lungs, the nasal mucous membrane and the submaxillary lymph glands. Where there are clinical symptoms of farcy the affected areas should of course, receive particular attention.

In far advanced cases there may be an extensive pneumonia, including ulcers that have caused considerable hemorrhage. In incipient cases, the kind that will ordinarily be seen, the lesions may be few and inconspicuous, consisting of small, scattered nodules, grayish on the outside and yellowish in the center, and surrounded by an inflamed zone. Commonly, in early cases the nodules are of about the size of mustard seed, some of them not more than half that size, and few larger than No. 6 bird shot. In other cases, the majority of the nodules are about one-fourth inch in diameter and otherwise present the same characteristics as the smaller nodules. These nodules are difficult to distinguish macroscopically from

All army horses are given a mallein test once annually. In addition they are tested at purchase, before release from quarantine, on change of station and when they may have been among civilian owned animals or have eaten from the same boxes or drunk from the same troughs as these animals. The official mallein test in the army is the intradermal test; the injection being made near the margin of the lower eyelid. When the injection is properly made superficial layers of the delicate skin are raised abruptly as if three-quarters of a small pea had been placed beneath the cuticle. The injection requires excellent restraint to enable the veterinarian to place the mallein into and not under the skin and to avoid unnecessary traumatisms to the structures. Traumatism may lead to swelling and confusion later in reading the test. The method shown in the illustration affords satisfactory restraint on tractable animals. When the injection is made, or sooner if the animal struggles, the ears should be twisted as strongly as may be necessary to keep it quiet. Obstreperous animals can be backed into a single stall or in a corner and in addition a twitch used. The illustration on the right shows an approved method of holding the syringe and making the injection into the hairless skin about one-fourth inch from the margin of the eyelid. The side of the hand is rested firmly against the masseter muscle and can thus follow movements of the head should any occur. The injection is made with a very small caliber needle (24 or 26 gauge) and after a few tests most animals offer little or no objection to the needle. Capt. A. W. Winter, V.C., is shown making the injection

old lesions, the result of previous parasite infestation. The inflammatory zone surrounding the glanders nodule is of differential significance. The irregular densities, resulting from the migration of Ascaris or other larvae should not be mistaken for the glanders lesion, as they are common in the lungs of nearly all horses and should be familiar to all who have performed autopsies on horses.

The appearance of the lesions of farcy and of nasal glanders already has been described. If any lesions are found on the Schneiderian mucous membrane, the submaxillary lymph gland should be examined.

The glanderous lymph gland is dense, irregular on the surface, and firmly adherent to the surrounding tissue. On being incised, numerous cheesy foci are revealed imbedded in dense fibrous tissue, white in color except for a zone immediately surrounding the cheesy foci where it is reddened by the inflammatory process.

6. *Prophylaxis.* — Army Regulations provide that all horses and mules shall be given the mallein test:

a. At the time of purchase.

b. Before being released from the 21day quarantine on arrival at their first station.

c. When they change stations.

d. At least once each year.

e. As frequently as may be deemed advisable in case glanders is detected among animals associated with them.

f. At any time it is suspected they may have been exposed, as when lost or strayed and returned to military control.

The intradermic mallein test is the standard test adopted for use in the army.

Army Regulations (AR 40-2110) gives in minute detail the manner in which a mallein test is given. The direction should be followed carefully.

In case it is doubtful, at the 60th hour, whether a reaction is positive or negative, a retest is made by injecting the lower lid of the other eye in the same manner as the first. At the same time a sample of blood should be drawn for a complement-fixation test.

Before testing, animals should be given a careful physical examination and the following classes excluded from the test.

a. Animals showing clinical symptoms of glanders.

b. Animals in which either eyelid is swollen.

c. Animals affected with purpura hemorrhagica.

d. Animals experiencing an acute attack of periodic ophthalmia or conjunctivitis or having a discharge from either eye.

Proper restraint at the time of making the injection is important—to prevent accidental traumatic injuries to the eyelid, which sometimes lead to doubt in interpreting the reaction.

The intradermic mallein test is a remarkably dependable one. However, great care should be exercised in its interpretation as an animal that has been purchased by the army, transported, trained and issued to troops, represents a very considerable investment and its replacement may be difficult. Many mistakes were made in the interpretation of the opthalmic mallein test during World War I.

Edema of the eyelid, epiphora, or even copious mucous discharge from the eye, 24 to 36 hours after the intrapalprebrel injection of mallein does not, if it clears up promptly, constitute a positive reaction to the mallein test or indicate infection. A positive reaction is indicated by a marked swelling, usually of both eyelids and frequently extending down the face, often a mucopurulent discharge, and photophobia present 72 hours or longer after the injection of mallein. Commonly, the positive reaction to mallein will show general malaise, lack of appetite, a pained expression and often some rise in temperature. The eye is very sensitive and the animal jerks its head if one attempts to touch it.

If the eye is clear and the edema has disappeared at the 48th hour after the injection, the interpretation of the test as negative is justified. Reactions that have not disappeared at the 48th hour should be held under observation 24 to 48 hours longer. A decision that the reaction is positive is not justified sooner than 72 hours.

U. S. Army Regulations provide that animals reacting positively to the mallein test or diagnosed as glanderous upon clinical examination shall be destroyed immediately.

Anthrax

1. *Synonyms.*—Charbon. In man: wool sorters' disease and malignant pustule (carbuncle).

2. *Geographical Distribution.* — Worldwide.

3. *Cause.—Bacillus anthracis.*

4. *General.*—Anthrax is not a disease of great military importance because, where good livestock sanitary practices prevail, the loss from it is rarely considerable. On the other hand it is a serious disease because of its wide distribution; the fact that it is not possible to entirely prevent it by sanitary measures and because of the hazard it constitutes to military personnel.

Anthrax is one of the ancient scourges. It is described in the early writings on animal disease. The fifth plague of Egypt, described in the Bible, was undoubtedly anthrax. The anthrax bacillus was the first microorganism to be described as a specific cause of a disease and anthrax was the first disease against which animals were artificially immunized. This was accomplished by Louis Pasteur in 1881 and established the foundation upon which subsequent immunological measures were founded.

Anthrax occurs to a greater or less extent in practically all countries. It is prevalent throughout India and the Middle East, in which sections livestock sanitary regulations, as we know them, are non-existent and carcasses are allowed to decay where the animal dies or are thrown into rivers. This results in practically all low land areas being contaminated with anthrax spores and animals grazing upon such land or camping upon it are exposed to infection. Anthrax is prevalent in Manchuria, where the army in the Philippines formerly purchased much of its beef.

The harmlessness and effectiveness of vaccination are so well established that it is unlikely military animals will be taken on foreign service without being immunized against anthrax. The problem of the veterinary officer will be that of protecting the military personnel from the use of the flesh of infected animals.

Anthrax is a disease that could be easily spread should the enemy resort to biological warfare. The organism can be produced readily in any quantity. The spores retain their infectivity for any required period of time and offer no difficulty of transport and delivery, either by air or by terrestrial agents.

5. *Symptoms.*—In solipeds symptoms are usually characterized by large subcutaneous swellings in the region of the sternum, beneath the abdomen and in the sheath; less frequently on the neck and throat. The temperature is elevated and the depression marked. The animals live from 12 to 72 hours after symptoms appear and about 5% recover naturally. The decomposition of carcasses of animals dead of anthrax is very rapid.

In cattle the disease is extremely acute and evidences, other than sudden death and rapid decomposition of the carcass, are seldom seen. In sheep the disease is even more acute than in cattle. They often drop dead while grazing, as suddenly as though shot. In swine practically the only symptom is a diphtheritic inflammation of the tonsils and pharynx and swelling of the lymph glands and surrounding tissues of the throat. This swelling may become so extensive as to suffocate the animal after three or four days but more often it disappears after three weeks and the animal recovers. Dogs are less susceptible than swine but are sometimes infected from eating the carcasses of animals dead of the disease. The symptoms are not characteristic but resemble those in swine.

6. *Lesions.*—Diagnosis of anthrax ordinarily will have to be made postmortem. Characteristic signs are oozing of dark nonclotting blood from the nostrils, mouth and anus, extreme bloating of the carcass shortly after death and rapid decomposition. The carcass should not be opened if there is reasonable certainty that the disease is anthrax. However, if it is opened, the spleen will be found to be greatly enlarged and the pulp and blood within it to resemble tar. Sometimes a diagnosis without

The zebu is widely domesticated in India—the home of anthrax, East Africa and in parts of South America. It is used chiefly as a draught animal

opening the abdomen can be made from the appearance of the subcutaneous abdominal veins. On laying back the skin, if these veins contain solidly clotted blood it is almost conclusive evidence that the disease is not anthrax. If, on the contrary, they are engorged with unclotted blood, black in color, it is strongly indicative of anthrax.

Diagnosis is confirmed by finding the anthrax organism in the blood on microscopic examination or by inoculation. It should be remembered that the bacilli occur in the blood, in large numbers, only immediately before death and for a short period afterward.

7. *Treatment.*—There is no known treatment for anthrax that possesses any value in cattle and sheep. In carnivora, antiserum is probably of value; in horses it is frequently disappointing. In man, the use of the serum constitutes a highly specific treatment.

8. *Prophylaxis.*—Animals acquire anthrax principally by ingesting the organism or from the bites of flies, chiefly the tabanids that have fed upon infected animals.

Infection by ingestion is acquired readily by grazing on infected pastures and overflowed lands. The lush grass, growing where an infected carcass has decomposed the preceding season, is particularly dangerous.

In the Middle East and in India, the custom of using animals to trample the grain from the straw is common and such grain is usually heavily contaminated with anthrax spores. Hay grown on infected areas is often contaminated with the spores and may be a source of infection to animals consuming it. Both grain and hay may be rendered reasonably safe by washing it, since mass ingestion of spores is usually required to produce the disease.

In districts where anthrax is common, military camps should not be made on overflowed land or land into which pastures drain. Dogs, and particularly jackals, should be prevented from carrying infection from carcasses into the camp.

Animals may be protected from tabanids and some other biting flies by keeping them away from brush and tall weeds.

The prompt and proper disposal of the carcasses of animals dead of anthrax is the most important means of preventing its extension. Carcasses should be burned or buried where they lie or, if this be impracticable—after plugging the natural openings, they should be moved to the place of disposal with necessary precautions to prevent contamination of additional areas. Oil should be poured over the area where a carcass has lain and burned.

Anthrax-vaccine should be employed for the protection of army animals, and under some circumstances for the protection of animals the army intends to use for food.

Army Regulations provide that all cases of anthrax in army animals shall be destroyed as soon as diagnosed.

Ulcerative Cellulitis

1. *Synonyms.* — Ulcerative lymphangitis, pseudo-farcy, pseudo-glanders, Preisz-Nocard disease.

2. *Geographical Distribution.* — France, Belgium, and the Philippine Islands.

3. *Cause.—Corynebacterium ovis* (Preisz-Nocard bacillus) and secondary infection with staphlococci, streptococci, and other organisms.

4. *General.*—This disease stood high on the list of those causing the greatest amount of incapacity of animals in the American Expeditionary Force in France. The British veterinary service ranked it third in causes of disabilities on the same front.

The Priesz-Nocard bacillus, which causes also caseous lymphadenitis in sheep, is generally regarded as the specific cause of this disease although this is doubted by numerous investigators. It is usually in the minority among organisms found in the lesions. Sometimes it cannot be found at all. Apparently it secretes a toxin that is responsible for the systemic effect of the disease. It is a saprophyte in nature and infection occurs through breaks in the integument, usually below the hock or knee, calk wounds, heel cracks, rope burns, etc. Ulcerative cellulitis is sometimes indistinguishable clinically from farcy. During the Philippine War (1902), it was so often diagnosed clinically as glanders that the mallein test became locally discredited.

During World War I both the American and the British veterinary service instituted research into the nature of this disease (Leibold, Watson). Each project developed a vaccine that was thought helpful but the end of the war and discontinuance of the projects came before anything of a positive value in either the prevention or the treatment of the disease was developed. It remains a serious plague of military animals in western Europe. In the Philippine Islands, where reports indicate that it was formerly common, the incidence of ulcerative lymphangitis among military animals has been low for many years, and of recent years practically nil. The possibility remains that under favorable conditions it may flare up almost anywhere since the Priesz-Nocard organism is widely distributed. Like a number of other pathogenic organisms, this one is prone to assume a virulence among military animals subjected to the close associations and hardships of a campaign of which it is never suspected from its relative innocuousness in the halcyon days of peace.

5. *Symptoms.*—The onset of the disease is characterized by sudden, hot, painful swelling, usually in the region of the metatarsus or metacarpus; in most instances accompanied by lameness, commonly extremely severe. The earliest diagnostic symptom is the appearance of small nodules of about the size of a pea or somewhat larger. Within a few hours these nodules break and discharge a sanguinous, thin pus. The suppuration extends rapidly into the inflamed cutaneous and subcutaneous tissues and, within two to four days, considerable sloughing takes place, leaving ulcers of varying sizes which continue to discharge serum and pus sometimes streaked with blood.

In some cases the nodular swelling and suppuration is less diffuse, and follows the chain of lymphatics, the vein becoming enlarged and palpable as a cord-like structure extending up the leg—similar to lesions of farcy and epizootic lymphangitis.

6. *Treatment.*—The treatment of ulcerative cellulitis is unsatisfactory. Serious cases with large sloughs are incurable and less serious cases, where healing of the ulcers is attained, frequently relapse — new ulcers suddenly appearing at the site of the healed lesions. This may occur in a few days to several weeks. In the British veterinary service in the World War I, the following classes of cases were considered non-treatable:

a. Showing ulcers above the hock or knee.

b. Showing more than two small ulcers below the hock or knee.

c. Showing a large extended (two or more ulcers coalesced) ulcer below the hock or knee.

Experience in France had convinced British veterinary officers that animals having such lesions should be destroyed at once.

In less severe cases, treatment consisted

of clipping the affected part, cleaning it thoroughly with soap and water, removing the necrotic tissue surgically, and painting the ulcer with tincture of iodine. The leg was then bandaged in an antiseptic pack. A solution of copper sulphate (1%) gave the best results. Rest, good feed and proper hygiene contribute to a favorable outcome.

There have been no reports of the use of the sulfa compounds in ulcerative cellulitis but from the results of its use in other suppurative conditions it would seem logical to give it a trial in this one. Clipping and cleaning the leg, packing the ulcer with powdered sulfanilamide and administering the drug internally (one grain per pound of body weight daily) might possibly give good results. The daily portion of sulfanilamide should be given in three doses and continued four days; then half this amount should be given for an additional four days.

Vaccine therapy, pyotherapy and serum therapy (use of diphtheria antitoxin) all have been recommended for both the treatment and the prevention of this disease. They have not received general recognition as being of any value.

7. *Prophylaxis.*—Nothing is known that is more effective in preventing ulcerative lymphangitis than to keep the legs clean, promptly treat all wounds and abrasions, however trivial, below the hocks and knees and to keep the amount of infection in the stables and corrals at a minimum by the early recognition and immediate segregation of all cases of the disease.

This airplane view of the 30th Veterinary General Hospital at DeQuincy, La., during the 1941 Army maneuvers, illustrates one type of camouflage. Instructions were that the type of installation should be concealed, but not necessarily the installation itself. There were approximately 600 horses in the hospital when the photograph was taken yet none of them are revealed in the photograph. It would have been very easy to camouflage the tents so that none of them could have been seen from the air (most of them are invisible in the photo) but concealing the roads from aerial observation would have offered considerable difficulty with the materials at hand. The highway (upper right hand corner) is State No. 7. In the lower right corner railroad tracks may be seen

Epizootic Lymphangitis

1. *Synonyms.* — African glanders, Japanese glanders, pseudo-glanders.

2. *Geographical Distribution.*—Continental Europe, Africa, Asia, Oceania.

3. *Cause.*—Probably *Saccharomyces farciminosus* (*Blastomyces farciminosus, Cryptococcus farciminosus*).

4. *General.*—In districts where it is indigenous, epizootic lymphangitis is probably one of the most difficult of all infections from which to protect military animals. Infection occurs through abrasions and wounds, which require careful protection to avoid contamination. In World War I, the British army veterinary service followed the plan of dressing all wounds with an antiseptic and a protective covering from the time they were discovered, and of destroying all animals infected with the disease as soon as a diagnosis of epizootic lymphangitis was made. They were able to hold their lymphangitis cases to small numbers in areas where the French forces had thousands of cases. Formerly this disease was thought to be confined to the warmer climates but of recent years it has been recognized in Finland and in northern parts of Russia. Exceptionally, it affects cattle.

5. *Symptoms and Lesions.* — Epizootic lymphangitis is an extremely chronic disease. The incubative period is six to eight weeks and the course two to four months or longer. The first symptom noted is nodules on the lymph vessels draining from the site (a wound or abrasion) of inoculation. As the disease progresses the nodules suppurate and the lymph glands, into which they drain, swell and often develop large abscesses. Lesions may occur on the nasal mucosa. Clinically, the disease is differentiated from farcy with difficulty. In other respects the symptoms and lesions resemble pustular dermatitis, phlegmon and ulcerative lymphangitis.

Diagnosis is confirmed by finding the fungus in smears from the pus. Farcy, of course, may be excluded by the mallein test.

6. *Treatment.*—The British experience in World War I, chiefly in France and in the Balkan Peninsula, indicates that, ordinarily, treatment of infected military animals is inadvisable. Cases were believed to present a hazard to other animals too great to justify retention of the affected animal in a hospital.

The experience of both American army veterinarians and civilian veterinarians in the Philippines where epizootic lymphangitis is common is at variance with that of the British in Europe. In the Philippines contact infection occurring in a hospital has been rare and only cases with extensive involvement are sacrificed. All others are treated. With proper treatment instituted at the outset of the disease 75 to 85% of the cases of epizootic lymphangitis recover. Essentially, treatment consists of surgical removal of the affected tissues and cauterization of the surgical wound. Cauterization may have to be repeated.

This American experience may not be duplicated under wartime conditions, but the method deserves a trial since if successful it will conserve animal strength.

7. *Prophylaxis.*—Prevention consists mainly in limiting the source of infection—animals suffering from the disease. In the Balkan campaign during World War I, the British veterinary service followed the plan of applying to all wounds a dressing composed of turpentine 5 parts, cresol 5 parts, petrol 10 parts and neutral oil to make 100 parts. Cotton saturated with this preparation was bound on the wound before evacuation and remained until removed at the veterinary hospital. The wounds reached the hospital clean and in good condition. To this practice and that of destroying cases as soon as detected, British veterinary officers attributed the remarkable freedom of British horses from the disease. Only a negligible number of cases of lymphangitis occurred during the whole campaign in the Balkans. A nearby French veterinary hospital contained 600 cases at one time.

Some degree of success in the prevention of epizootic lymphangitis has been reported from the employment of vaccine therapy, pyotherapy and serum therapy. Their usefulness, however, is by no means established.

Dermatitis Gangrenosa

1. *Synonyms.*—Necrotic dermatitis, gangrenous dermatitis.

2. *Geographical Distribution.*—Probably everywhere.

3. *Cause.—Actinomyces necrophorus.*

4. *General.*—This rather obscure ailment may be responsible for much loss among animals compelled to stand in mud and filth, particularly in cold weather. When animals can be given dry standings, it occasions no difficulty. While the cause is generally attributed to the necrophorus bacillus, as in other infections of that organism it may not be the primary cause but a secondary invasion, following injury to the tissue, by toxins of other organisms, freezing or maceration by mud and water, particularly in cold weather.

5. *Symptoms.*—The first symptom noted is usually extreme lameness. On examination of the extremity, areas of various size, from ½ to 2 inches in diameter, are found about the pastern or on the heels where the skin is inflamed, firmer than normal and sensitive to pressure. The area often includes a slight abrasion or deeper wound which may have afforded the necrophorus organism entry.

The affected tissue soon feels leathery to the touch and in time separates from the surrounding tissue. The necrosis extends more or less deeply into subadjacent tissues and ultimately a section sloughs out. The necrotic tissue may extend to the bone. Open joints often result from such sloughing and the hoof may be shed. The lesion presents the characteristic foul odor of necrophorus infection. Recovery is the rule unless metastasis occurs, however the animal may be of little use thereafter.

Until the eschar separates from the healthy tissue there may be considerable fever and other constitutional disturbance, all of which vanish quickly when the diseased tissue is detached leaving a healthy granulating surface.

In severe cases the toxemia may be more marked, and even death may occur. This latter eventuality is usually a result of metastatic foci of necrophorus organisms developing in the lungs or elsewhere.

Quittor is a common sequel to gangrenous dermatitis as is also periosteitis and, as already mentioned, arthritis. Where there is extensive destruction of tissue, deformity may result even though the healing progresses favorably.

6. *Treatment.*—Nothing but the natural resistance of the tissues seems to have much effect in stopping the process of necrosis. The treatment most used has been the bichloride of mercury (1 to 500) pack. Better

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results seem to have followed the employment of packs of saturated solution of Epsom salt.

7. *Prophylaxis.*—All that is needed to prevent the development of necrotic dermatitis is good sanitation. It does not develop in animals on dry standings. If such cannot be provided, removal to "clean" mud slows up the extension of the infection.

Animals required to work in mud or filth should be groomed twice daily, special attention being given to the feet and fetlocks. All wounds, however slight, of these parts, should be treated promptly and the animals given dry standings when not at work. The fetlocks should not be trimmed in cool or cold weather. After washing mud from the legs they should be dried immediately by friction.

Corrals are objectionable under any circumstances and particularly so in the presence of this disease. If they must be used not more than 50 well animals should be confined in any one enclosure.

Respiratory Diseases

In all past wars respiratory diseases have taken a terrible toll of army animals. In his work "Animal Heroes of the Great War," Earnest Baynes said of American experience during World War I:

"In the handling of public animals during the war, the haste of the emergency and our own inexperience made it impossible to observe well known principles of animal hygiene. Consequently, morbidity and mortality ran high. Buying and shipping were active. Railroads were congested, shipments suffered delays of days and weeks and the federal law which requires that all animals be unloaded for food, water and rest once in each 28 hours was not enforced. . . . Stockyards and cars were infected with influenza, strangles, etc. . . . —Some animals were sick when unloaded, others became sick in transit and many arrived dead or incurably sick. Unfortunately, animals left the cars for conditions as bad as, or sometimes worse than, those in transit. Most of the remount depots were overcrowded and decidedly insanitary. Many were located on low land with clay subsoil and the corrals became seas of mud."

"Veterinary Military History of the United States" says of the same conditions:

"The morbidity from virulent respiratory infections became appalling during the winter of 1917-18, in the United States, as well as in France, owing to agglomerating thousands of 'green' animals where no provisions for the sanitary handling of them had been provided. Everywhere at home and abroad, public animals were exposed to inclement weather, mud-puddled ground, filthy watering troughs, and accumulated droppings. . . . Lack of understanding and not of means nor money was the obstacle."

And again:

"The execrable insanitary conditions baffle any attempt to portray them in mere words. Filth, stench, diseases, exhaustion, exposure and general despair overwhelmed both animals and personnel, and the loss from disability and death not only made incomputable inroads upon the national wealth and available supply of animals but also seriously hampered the operations of the combat troops."

Writing of conditions at auxiliary remount stations the Surgeon General of the Army, in his annual report for 1919, said:

"The ever-present picture of large herds of animals running loose in corrals, extensive areas of which, were knee deep in mud and manure, did not change until the animals died or were disposed of. . . . There was no avoiding these insanitary conditions based as they were on an inherently incorrect principle. The corral for general use in the United States is a failure and should not be tolerated in the future."

The diseases referred to in the foregoing were the common communicable respiratory diseases of horses. Mainly strangles, influenza and infectious pleuropneumonia.

These quotations show that such diseases may become a scourge of the first magnitude in army animals.'

12TH CAVALRY MOUNTS, FORT BROWN, TEXAS

Southernmost Army Post in Continental United States. Lieut. Gen. Jonathan M. Wainright (then a brigadier general) was in command of the brigade to which the 12th Cavalry belonged at the time photograph was taken (Feb. 1939)

Except at long intervals the loss among civilian-owned horses from respiratory diseases has not been large. The loss of seasoned army animals from these diseases is practically nil during peace time. There is some loss among animals newly acquired by the army even in normal times but it is not serious. It is the violation of every law of hygiene and sanitation, the abuse of animals by train journeys of 40 to 60 hours without feed, water or rest; exposure to mass infection and inclement weather in overcrowded filthy corrals and the agglomeration of vast numbers of unacclimatized animals that convert respiratory diseases of horses and mules into a catastrophe for the army and the nation. Under such conditions the loss is appalling not only among newly-purchased animals but also among debilitated, seasoned animals, as a result of mass infection carried to them by the infected remounts.

The respiratory diseases of importance to army animals other than glanders which is discussed elsewhere are: strangles, influenza, infectious bronchitis, pneumonia, and purpura. The latter is not communicable in the usual acceptance of the term but infections with which it is commonly associated are communicable, hence, it is discussed with communicable diseases. Some pneumonias are not regarded as being infectious but the type most common among military animals is communicable.

That "shipping diseases" or "shipping fever" are not inseparable from the rail transportation of army animals is shown by the experiences of the 1st Cavalry Division and the 55th Cavalry Brigade in the summer of 1941. These organizations shipped all their animals, some 9000 horses and mules from Fort Bliss, Texas, to the maneuvers in Louisiana, a distance of 1000 miles and not a single case of strangles nor influenza and only one case of pneumonia developed as a result of the movement. They were seasoned animals and were under veterinary supervision at all times during the loading, the rail journey and the unloading, both enroute and at destination. That is the way to move masses of animals to other than slaughter. The public and too often transportation officers do not realize this. They see millions of animals transported to market with minimum loss from disease. They do not realize that the celerity with which the slaughter pen replaces the railroad car or truck prevents the development of an incalculable amount of disease.

Col. Jack Fuller (extreme right) and veterinary officers from Medical Field Service School, Carlisle Barracks, Pa., visit Front Royal Remount Depot, Front Royal, Va.

Strangles

1. *Synonyms.*—Colt distemper, infectious adenitis.

2. *Geographical Distribution.* — World-wide.

3. *Cause.—Streptococcus equi* and possibly a virus.

4. *General.*—In annual reports of the Surgeon General of the Army, strangles stands high among the causes of veterinary hospitalization. In the year ending June 30, 1941, it was first among infectious and parasitic diseases in the number of admissions accounted for and was responsible for a greater number of admissions to the register of sick and wounded than all non-infectious respiratory diseases combined.

That the *streptococcus equi* is the specific cause of strangles is accepted by most authorities but others doubt that such is the case. Some characteristics of the disease indicate the primary cause may be a virus and that the streptococcus is merely the most important of the secondary invaders.

An attack of strangles confers a fairly high degree of immunity that lasts for a number of years. Other things being equal the younger the animal the more severe the attack, and the shorter the period of immunity. Thus foals that suffer an attack during the suckling period are quite likely to have a second attack when they go on the market three to five years later. Like the immunity to a number of other diseases, the resistance to strangles can be overcome by hardship, exposure, exhaustion and debility. The amount of infection too plays an important role in breaking down resistance.

During the fiscal year referred to above, the army purchased 18,545 animals and the veterinary service reported 1,688 cases of strangles. Even if all cases occurred in newly purchased animals, the incidence was only 9%. This probably represents about the minimum at which the disease can be held. During World War I the incidence was many times higher among horses purchased for the American and French armies and considerably higher among Italian and British purchases. There is a possibility that some of the 850 cases reported as rhinitis may have been mild attacks of strangles but even if half of such cases were strangles, and that is scarcely probable, the incidence among newly purchased horses last year was still extremely low. This is to be attributed, in the main, to the care with which the animals were selected at purchase and to the good management and good sanitation that obtained during shipment. The incubation period of strangles is four to ten days. Sometimes many cases will occur within 24 hours after a group of highly susceptible animals are exposed to conditions favorable to the disease—such as severe chilling after a fast ride or standing in a cold rain. The explanation of this sudden onset is not clear. It is an exceptional occurrence.

Symptoms.—Mild attacks of strangles may amount to little more than a nasal catarrh. The elevation of temperature is transient, the appetite unimpaired and the sub-maxillary glands little affected. These mild cases recover spontaneously if protected from chilling and otherwise given good nursing. When occurring singly, such cases cannot be distinguished from simple catarrh. It is only by more severe cases occurring in the same group of animals at the same time, that they are recognized as strangles.

The typical case of strangles is more severe than that discribed in the foregoing. The nasal catarrh runs rapidly through the stages of serous, mucous, mucopurulent to purulent. There is a conjunctivitis more or less severe and a pharyngitis. The submaxillary lymph glands instead of being slightly enlarged, as is commonly the case in simple catarrh, are much enlarged, hot and painful and soon suppurate. The temperature is high, until the abscesses are evacuated, the appetite in abeyance and, because of the pharyngitis, water returns through the nose when the animal drinks. There is an annoying, unproductive cough. Even in these cases the mortality is low and recovery prompt after evacuation of the abscesses if the animal be cared for well.

Strangles is prone to grave and even fatal complications from rather trivial causes—exposure to a cold wind, an hour in a chilly

rain, confinement in an unventilated stable where the humidity runs high, a few hours at hard work or a rail journey. Any of these factors may result in laryngitis with perhaps edema and death; bronchopneumonia with prolonged convalescence or fatal termination; inflammation of the gutteral pouches, parotitis, suppuration of lymph glands in various parts of the body and even generalized septicemia. All of these complications are serious and the mortaility, in cases so complicated, is high, and even though the animal survive it is likely to suffer impairment of its usefulness.

An animal that develops strangles during or soon after a rail journey or an animal that has recently passed through a public stockyard or sales stable is quite likely to develop influenza also. Such cases usually are severe to grave. The symptoms of both diseases are superimposed one upon the other and in addition the cutaneous lymph glands about the head and throat may also become infected, swell enormously and eventually suppurate. Such an animal presents the appearance of purpura of the head, face and neck. However, the swelling is differentiated from that of purpura by being hot and painful.

Differentiating strangles and influenza by the clinical symptoms alone is often difficult, particularly so when they coexist. Some are prone to call the disease strangles if it occurs in young animals, but if the mature become affected to designate it influenza. Age in this instance is not an infallible criterion. Strangles spreads readily among animals of any age if they are maintained under grossly insanitary conditions, overcrowded or severely debilitated, and where the infection is ingested in large quantities; as in drinking water highly contaminated with nasal discharge of infected animals.

Treatment.—All general infections, from which recovery is hoped, require supportive and symptomatic treatment. Even when no specific treatment is known, treatment—nursing and medication—that alleviates the distress of the patient, contributes to its strength in the battle with the infection and promotes and hastens recovery, is demanded. In perhaps no other infection is the reward of good nursing so evident as in cases of strangles in young animals.

In all but the mildest type of strangles the afflicted animal presents a picture of misery and agony. The temperature is high, the breathing labored, the head extended to relieve the painful swelling of the throat, the nostrils are nearly plugged with mucous and pus, the eyes hurt, the swollen lymphatic glands are so many centers of throbbing pain, the pressure on the delicate membranes of the nasal chamber causes acute distress; swallowing, even water, causes excruciating pangs in the pharynx, in the larynx and wherever the esophagus impinges upon the trachea. A racking, dry cough adds to distress, discomfort and pain.

View of the Veterinary Hospital Area at Front Royal, Virginia

Much can be done to alleviate this acute suffering. The animal should be kept warmly blanketed, if necessary, and the legs bandaged to support the circulation. It should be groomed thoroughly at least twice daily. It should be turned into a corral on warm sunny days but always stabled at night and on cold or rainy days. The stable should be warm and it must be well ventilated. Hot or humid buildings aggravate all distress. The pus should be cleaned from the nostrils and the surfaces coated with petrolatum frequently. Clean water should be available always, where the head will not need to be lowered much to drink it. The animal should be offered soft, fresh, clean food often as, even when the animal is unable to swallow, attempting to eat will improve the condition of the mouth, which is usually foul.

Of the symptomatic medication nothing else probably gives so much immediate relief as irrigation of the nasal chamber. A

warm solution containing one dram each of sodium chloride and sodium bicarbonate to a quart of water is recommended. Irrigation may be accomplished by means of a fountain syringe and the use of a soft rubber catheter with many side holes cut in the distal four inches. This should be passed as far into the nasal cavity as possible, and copious quantities of water used. The nasal chamber should be irrigated frequently. After the discharge becomes mucopurulent or purulent, the washing may be followed with advantage by lavage with a 1% alum solution. This astringent decreases the congestion in the Schneiderian membrane and lessens the discharge.

The eyes too should receive attention. Keep the discharge cleaned away and instill a saturated solution of boric acid or 5% solution of sodium bicarbonate into the conjunctival sacs frequently.

Abscesses should be drained as soon as it is certain the swollen glands contain pus. A fall in temperature and marked general improvements occurs immediately the pus is evacuated. As good results are obtained from evacuating a spoonful of pus from a gland (when that is all there is in it) as from waiting until the abscess "points" and then evacuating, perhaps a half-pint of pus. Recovery is hastened, complications possibly prevented and destruction of tissue lessened by the earlier operation.

In general infections, where there is a high temperature and an acute toxemia for a considerable period, the heart suffers from malnutrition and over-work. Two agents, digitalis, and dextrose intravenously, stand out as corrective and supportive measures to conserve the strength of the heart under such conditions. Foreseeing the possible development of pneumonia as a complication, these agents should be used early in grave cases of strangles.

Seymour and Stevenson[1] used strangles antiserum (prepared by the Army Veterinary Laboratory of the Eighth Service Command) in a long series of cases of strangles, with gratifying results. They administered it intravenously in doses of 100 to 200cc daily until marked improvement set in, then every second day for a few days and later at longer intervals. Frequently an equal quantity of normal saline solution or one half the quantity of 50% glucose solution was added to the serum injection. In cases showing marked symptoms of septicemia, 60 to 90gm of sulfanilamide was administered *per os* daily for four days.

The use of blood plasma in the treatment of strangles appears not to have been reported. Reasoning from its extensive use in man and its very limited use in horses in acute infections, it seems probable that it would be as effective as convalescent serum and possess several advantages over the serum. A trial of it, particularly of dried plasma instead of the serum, is suggested.

The use of sulfanilamide in the treatment of strangles seems not to have been reported, except in the very restricted way mentioned in the foregoing, and by Bazeley (*Vet. Rec.* 53:50 pp. 730-33) who found it unsatisfactory. Because of its remarkable efficacy in other streptococcic infections, it merits a trial as the principal medicament in this disease. Judging from its use in other infections in the horse, the dose should be 1 to 1½ grains daily per pound of body weight. This quantity should be divided into three doses and administered at 8-hour intervals, continued for four days, then half the quantity should be given for an additional four days.

Always, in severe cases of strangles, there is danger of suffocation, either from edema of the larynx, or closing of the trachea from the pressure of a swollen lymph gland or an abscess. Intubation should be performed at the first sign of suffocation.

Prophylaxis.—There is no biological product of unquestioned value in the prevention of strangles. Of the many preparations, that have enjoyed a more or less ephemeral reputation in the field, *Streptococcus equi* bacterin has achieved the greatest popularity. Comparatively few, however, have retained faith in it for more than a short time.

The greatest protection lies in avoiding those insanitary conditions named in the foregoing as contributing to the severity of the attack; in an early recognition and strict segregation of cases and in measures to enhance the vigor of uninfected animals.

[1] Seymour, R. T., Lieut. Col., V. C. and 1st Lieut. Daniel S. Stevenson, 1942. *Army Vet. Bul.* 36:2, pp. 81-92.

Equine Influenza

1. *Synonyms.*—Shipping fever, pink eye, catarrhal fever, stockyard fever.

2. *Geographical Distribution.*—All parts of the world.

3. *Cause.*—A filterable virus.

4. *General.*—Influenza is constantly present among solipeds in the United States and all other major horse raising countries. Like influenza in man it occasionally occurs in panzootics. One such epizootic wave, about which little is known, occurred in the United States in the 1830's. In 1855-56 and again in 1871-72, great panzootics of equine influenza occurred which, for weeks, paralyzed transportation in all large American cities—in fact put ox teams on Broadway (New York) and State Street (Chicago). During World War I, it was present in epizootic proportions in the remount stations of all armies.

Among small numbers of animals that are well cared for, influenza usually runs an uncomplicated course and the mortality is light—less than 0.5%. Where large numbers of "green" horses are assembled; where they are subjected to the hardships of shipment; exposure to inclement weather; crowded into insanity corrals or forced to endure other devitalizing influences, it becomes a devastating scourge prone to complications, particularly pneumonia, from which the mortality is high. Under unusually unfavorable circumstances the mortality was 100% among approximately 1000 animals in at least one instance in France during World War I.

The virus is present in all body fluids of the infected animal and is spread by the eye and nasal discharges, the saliva, semen, urine, feces, contaminated drinking water, feed and surroundings. Recovered animals carry the infection in their blood for an extended period. Bergmann reported finding it in the semen of a stallion that had recovered from the disease six and one-half years earlier.

Three types of the disease—nasal, pulmonary and intestinal—are common. They have been regarded as separate entities by some. During World War I, there were a great many cases in which intestinal involvement predominated. Since influenza was looked upon as a respiratory disease, this mainly intestinal ailment was thought by many to be a different disease. Few such cases have been reported since the close of the late war, but with the better understanding of viruses and their tendency to exhibit tissue specificity, the consensus is that this intestinal disease is due to the influenza virus, which for some reason has found the mucous membrane of the intestinal tract more congenial to its development than was found in the respiratory organs.

The other two types of influenza—catarrhal and pneumonic—some also regard a being due to different viruses. However, the majority regard the latter as an extension or sequel of the former. The whole subject of influenza is about as clear as a bottle of Grade A pasteurized milk.

As was stated in the discussion of strangles, that disease and influenza resemble one another in many respects. Much of the discussion of strangles applies equally to influenza and need not be repeated. Such differences as obtain are mainly differences in degree. The temperature is rather higher in influenza than in strangles—107°F. being commonly reached; the cough is more pronounced; the tendency to develop into pneumonia is greater; the incubation period is shorter—rarely more than six days and sometimes apparently only one day; the course is more acute; suppuration of lymph glands is not so universal; the swelling of tendon sheaths, tendinitis and arthritis are more common, and vigorous animals escape the attack in a far higher percentage than is the case with strangles. Finally unlike strangles, the age of the animal does not affect its susceptibility to influenza.

"Shipping fever" is more applicable to influenza than to strangles, since outbreaks commonly originate in market centers or on rail journeys. Strangles as we have seen, although it may originate in a similar manner, is also indigenous in practically all studs of considerable size.

5. *Symptoms.*—Attacks of influenza begin with malaise, loss of appetite, a high temperature and inflammation of nasal mucous membrane from which there is a serous discharge. The nasal involvement may progress as a simple catarrh or the discharge may cease before reaching the purulent stage. Laryngitis, accompanied by a harsh, dry, painful cough, is an early symptom. The cough becomes more moist as the catarrh extends to the bronchi. At first, the eyes present a photophobia followed by acute conjunctivitis and there may be considerable swelling of the eyelids. There is stiffness and tenderness of the muscles all over the body and an extensive tendinitis and synovitis—the joints creaking and crackling when the animal moves. The head is extended, there is extensive swelling of the gutteral region and suffocation may ensue. By the third day depression is marked. Exacerbations occur frequently with the advent of stormy weather, even though the animals be not exposed to it; resembling in this respect rheumatic attacks.

The inflammation is prone to extend to the lungs and result in anything from increased vesicular murmur, to pleuritis, and lobar pneumonia, oftentimes with fatal termination.

6. *Treatment.*—The treatment of equine influenza does not differ materially from that recommended for strangles except that incising abscessed lymph glands is not so commonly necessary. The same good nursing; the same protection from chilling; the same protection from stifling stable atmosphere; the same support of the heart and the same watchfulness to prevent suffocation, are as necessary in the treatment of influenza as in the treatment of strangles. Where catarrhal symptoms are prominent, nasal irrigation gives the same marked relief that it does in strangles.

Seymour and Stevenson received much satisfaction from blood transfusion (500cc daily) in depressed and weakened cases and from neoarsphenamine (3gm in 200cc of distilled water intravenously). The neoarsphenamine injection was given every other day in a long series of cases. When administered early in the attack, the temperature fell promptly and the general appearance and attitude were much improved.

A freshly prepared aqueous solution of mercurochrome (200cc of a 1% solution daily) administered intravenously, gave gratifying results in the small number of

Army Veterinary Hospital, Fort William McKinley, Philippines

cases on which it was tried. The same authors also found that seven grains of potassium iodide (daily for three days), in a gallon of water, via stomach tube, was most useful in cases in which there was great swelling about the throat. It avoided the need for intubation in most of such cases. Strychnine sulphate and camphor in oil was employed, by these authors, to combat the depression.

Cases with grave intestinal involvement run a rapid course, usually to a fatal termination. Prompt supportive measures, plasma injections or blood transfusions, strychnine, digitalis, etc., are required. The dehydration must be overcome and the depleting diarrhea brought under control within a few days or death is inevitable. For the dehydration intravenous injections of a hypertonic saline solution and drinking water *ad lib.* are required. For the diarrhea tincture of opium is a specific but since it is difficult to obtain, the new drug sulfaguanidine deserves a trial.

What was said of the reliance upon sulfanilamide in strangles applies with equal force to influenza, since the principal secondary invaders are *Streptococcus equi* and *Pasteurella equiseptica* of which the former is the commoner and the more important of the secondary invaders.

7. *Prophylaxis.*—No specific immunizing agent against equine influenza is known. Reliance must be placed upon early recognition, prompt segregation, good sanitation and hygiene, and the avoidance of those conditions that contribute to the onset and severity of the disease.

Equine Contagious Pleuropneumonia

1. *Synonyms.* — Equine croupous pneumonia.

2. *Geographical Distribution.* — Worldwide.

3. *Cause.*—A filterable virus with *Streptococcus equi* and often *Pasteurella equiseptica* as secondary invaders.

4. *General.*—All pneumonias in the horse are due to bacterial action. Some are due to organisms, normally present in the respiratory tract, which become pathogenic because of injury to the respiratory mucous membrane from irritants or disturbed circulation. They are not regarded as communicable. The task of determining by clinical examination and anamnesis, whether a sporadic case of pneumonia is or is not infectious and contagious is often difficult. The circumstances attending and preceding the development of the case should receive careful consideration since the course and symptoms may be identical in infectious and non-infectious types of the disease. Both types require segregation, but only the infectious type requires strict quarantine and elaborate disinfection. Where there is doubt the case should be regarded and handled as infectious.

Equine contagious pleuropneumonia is the type of pneumonia most common among army animals. The predisposing causes are the same as those of influenza. The primary cause is a virus. Much evidence has been adduced to indicate that the virus of pneumonia is distinct from the virus of influenza and the viruses that are suspected of causing strangles and colds but none of it is conclusive. Like influenza, virus pneumonia is complicated by a secondary infection of *Streptococcus equi* and usually also by *Pasteurella equiseptica.* In addition a large number of organisms, normal saprophytic inhabitants of the respiratory tract, are involved in the inflammatory process. Because of the unknowns in the etiological consideration of equine contagious pleuropneumonia, it is not possible to say definitely whether it is an extension, a complication, a sequel of influenza, or whether it is a concurrent infection due to the same predisposing factors but to its own specific virus. It should be differentiated from the following types of pneumonia.

a. Croupous pneumonia (non-contagious) is due to organisms that are ordinarily saprophytes in the respiratory tract of the horse. Their pathogenicity is brought about by external influences, such as cold, irritating fumes, overexertion, transportation, permanent stabling in insanitary buildings, etc., that lower the resistence of the pulmonary mucous membrane to bacterial invasion. It is lobar in type.

b. Catarrhal pneumonia, bronchopneumonia, lobular pneumonia, (non-contagious) is usually preceded by a bronchitis. It is commonly due to the entrance of foreign bodies into the bronchi, to parasites, or the inhalation of very hot air, smoke, or irritant gases. The same organisms that cause croupous pneumonia are involved, but in this type the *P. equiseptica* is the more likely to be a factor. Unhygienic conditions and exposure to cold are important predisposing causes. Gangrenous areas are prone to develop at the site where these foreign bodies, whether liquid or solid, lodge. It may be followed by purulent pneumonia or general pulmonary gangrene.

c. Chronic interstitial pneumonia is differentiated from the infectious types by its chronicity and the fact that it is ordinarily an extension of chronic catarrhal bronchitis.

d. Pneumonia due to gas poisoning (chemical warfare agents) is characterized by the sudden development of a distressing cough, an acute bronchitis and, in severe cases, the development of severe pulmonary edema signalized, within 24 hours, by a trumpet-like dilation of the nostrils. Another symptom of differential, in fact, of pathognumonic significance when present, is the very early onset (often within 12 hours) of a profuse nasal discharge—grayish-white or greenish-yellow in color, sometimes flecked with blood. In some cases the odor of the gas used can be detected on the breath. Always a rapid pulse, vesicular murmur and evidences of pharyngitis and

PART OF THE BROODMARE BAND AT FRONT ROYAL REMOUNT DEPOT

bronchitis precede the elevation of temperature by some hours.

5. *Symptoms.* — Where equine contagious pleuropneumonia follows an attack of strangles or of influenza, the symptoms of the former diseases gradually are merged with those of the pulmonary disease or more often the latter are merely added to the former. Where the pneumonia appears as the primary infection (pulmonary form of influenza) there is an abrupt rise of temperature (104 to 106°F.). The respirations increase to 30 or even 60 and the pulse from 50 to 100 per minute. Sometimes, but not commonly, there is a slight yellowish, or more often, brownish discharge from the nostrils. A variety of rales are present depending upon the stage and degree of bronchial involvement. Pleurisy is always present in greater or less degree from the fourth day and modifies the breathing. At about this time symptoms of cardiac involvement supervene; the pulse becoming arythmic and weakened. The temperature falls either gradually or rapidly after about ten days and convalescence begins; or in fatal cases there is increasing cardiac disturbance, the nasal discharge becomes bloody or icteric, the breath has the odor of pulmonary gangrene, hydrothorax becomes pronounced and the patient succumbs from toxemia and circulatory failure.

6. *Treatment.* — Equine infectious pleuropneumonia requires the same good nursing that is imperative for strangles and influenza. Protection from cold, from drafts, from getting wet, and from stuffy ill-smelling stables, are primary requisites as is also good grooming; bandaging the legs when needed; bathing the eyes; blanketing when the atmosphere is chilly, furnishing fresh clean drinking water and clean appetizing feed. The manger and feed box should be washed and disinfected daily. On warm quiet days the sick animal will benefit much from standing in the sunshine several hours.

For feed, Seymour and Stevenson recommend alfalfa and prairie hay and a grain mixture comprised of 320 pounds crushed oats, 50 pounds bran, 20 pounds linseed meal and 10 pounds of brown sugar. The animal should be fed all it will eat and salt should be kept constantly available.

Supportive treatment should include fluid extract of nux vomica to stimulate the appetite and as a general tonic; digitalis to support and rest the heart, and tradition requires Fowler's solution. If the animal drinks but little, as is apt to be the case when digitalis is administered, thirst should be stimulated by intravenous injections of hypertonic saline solutions. One thousand cubic centimeters of a 10% salt solution (sodium bicarbonate 5%, sodium chloride 4%, magnesium chloride and potassium chloride aa. 0.5%) will cause the animal to drink several gallons of water immediately. During the latter half of the course of the disease, when the heart is showing the effects of the general intoxication, intravenous injections of 50% glucose solution should be given in addition to the digitalis. This will nourish the overburdened heart and improve the circulation, and at the same time combat dehydration by causing the animal to drink copiously.

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As soon as the rales become crepitant or moist, ammonium carbonate or ammonium chloride should be given to liquefy the exudate in the bronchioles and air cells and to facilitate its removal. However, if ammonium chloride is given in full dosage for longer than about six days it will increase the cough to an exhausting degree. It should be discontinued when this effect begins.

In a crisis, for a quick temporary lift, 2000cc of blood may be given by direct transfusion. If indirect transfusion is employed, the injection of this amount of citrated blood should be preceded immediately by an intravenous injection of 30 to 50gm of calcium gluconate.

The sheet anchor in the treatment of equine pneumonia of all types is sulfanilamide. The earlier its administration is commenced the more efficacious it proves. A horse weighing a thousand pounds should receive 20 to 30gm every eight hours until 24 hours after the temperature falls to not more than one and one-half degrees above normal. The dose should then be reduced to 15gm three times daily and continued at that level for four days. It is very important that sulfanilamide be administered at not longer than eight-hour intervals. It is eliminated rapidly and if not administered at eight-hour or shorter periods, the effect is not continuous and it is nowhere nearly so efficacious as when given properly.

The best method of administering sulfanilamide to a horse is in capsules, however, in infectious pleuropneumonia there is sometimes so much pharyngitis as to make this hazardous. The drug is insoluble in ordinary solvents but can be washed down in suspension in molasses through a stomach tube if the pharynx is in condition to permit its passage.

7. *Prophylaxis.*—The prevention of equine infectious pleuropneumonia in no way differs from that of equine influenza which is discussed elsewhere.

In all military campaigns heretofore conducted in the Middle East chief reliance for transport has been upon the camel—"ship of the desert"

Purpura Hemorrhagica

1. *Synonym.*—Petechial fever.

2. *Geographical Distribution* — Worldwide.

3. *Cause.*—Unknown. Likely a toxemia; possibly an anaphylaxis.

4. *General.*—Purpura hemorrhagica is not infectious and cannot be produced artificially. It is, however, always associated with microbic action. In army animals it is ordinarily a sequel to strangles, influenza, infectious pneumonia or pharyngitis and rarely to nasal catarrh and chronic sinusitis. Essentially it is an impairment of the blood vessel walls that permits the blood plasma, and to a lesser extent the whole blood to escape into the tissues and cause sharply circumscribed swellings. All the other symptoms are secondary and due to mechanical interference, impaired nutrition or secondary bacterial invaders.

The condition *per se* is afebrile. Elevation of temperature that may exist in the beginning, is due to the primary disease and, late in the attack, to toxins produced by the secondary infection. The course of the ailment is exceedingly variable. The progress of the swelling and the extension of hemorrhages may be arrested at any time or the condition may last for weeks, entailing great loss of flesh through a greatly prolonged convalescence or terminate fatally. On the other hand the condition may be very acute and terminate fatally in 12 hours to two or three days—usually in these peracute cases the mortality is from suffocation.

Purpura hemorrhagica may occasionally occur from causes other than those mentioned in the foregoing. Such cases have not been reported in army animals.

5. *Symptoms* and *Lesions.*—Small hemorrhages into the nasal mucous membrane are quickly followed by edema of the subcutaneous tissue of the nose and face. After a varying period the legs swell—the edema beginning at the feet and extending up the legs but always ending abruptly at the top. Urticaria-like swellings may appear on various parts of the body. The swellings are cold, painless and pit on pressure. The petechial hemorrhages extend to all the mucous membranes in the body and later into the skin, the subcutaneous infiltration, the muscles, periostium, etc. Ulcers frequently develop in the intestinal and conjunctival mucous membranes. Slight to severe or fatal edema occurs in the lungs. Swelling in the nasal mucous membrane or in the larynx may cause suffocation.

Where the swelling is extreme, as it frequently is, the skin is prone to crack and pieces of it slough out after 10 days to two weeks. The subcutaneous extravasate may be one to two inches deep. In time it is invaded by putrefactive bacteria and gangrene, sloughing and toxemia ensue. Until this occurs the temperature is normal and the breathing normal to labored, depending upon the amount of involvement of the respiratory organs. The hemorrhage into the masseter muscles makes eating difficult. The hemorrhage into the locomotory muscles renders movement unsteady and perhaps painful. There is usually a persistent diarrhea with putrid smelling feces mixed with shreds of tissue.

6. *Treatment.*—When no treatment for a condition is effective, invariably many are recommended. This is conspicuously true of purpura hemorrhagica. Among biological remedies large blood transfusions and intravenous injections of antistreptococcic serum have the greatest number of advocates.

Among chemical remedies the intravenous injection of formalin ranks easily first in the number who use it. One to three drams are administered daily in 1 to 2% aqueous solution. Second in popularity is acriflavine, 200 to 300cc of a 1 to 1000 solution.

Among the newer agents, vitamin K, oxalic acid, thrombin, and blood plasma would seem worthy of trial.

The trachea tube should be inserted if suffocation threatens. The sloughing should be treated surgically.

In any case good nursing, deep bedding, removal of pressure (halter), restricted movement, fresh water, palatable, easily-

digested feed, good grooming, comfortable surroundings, etc., are prime requisites.

7. *Prophylaxis.*—The prevention of purpura hemorrhagica depends upon the prevention of the primary diseases to which it is a sequel. The factors that bring about the sequel are not understood and no means of preventing them are known.

Hemorrhagic Septicemia

1. *Synonyms.*—Shipping fever, stockyard fever.

2. *Geographical Distribution.* — Worldwide.

3. *Cause.* — *Pasteurella equiseptica* (equisepticus).

4. *General.*—There is a pasteurella or bipolar organism for each of the domestic animals, boviseptica, suiseptica, oviseptica, aviseptica, bubalseptica (water buffalo), leptiseptica (rabbit), etc. These organisms are widely distributed in soil, water and in the respiratory and digestive tracts of animals where they are normally saprophytic. What causes them to become highly virulent and set up a disease which is readily transmitted is speculative. It probably occurs less frequently in the horse than other domestic animals and fowl. Some veterinarians habitually refer to particularly acute and malignant cases in outbreaks of influenza as hemorrhagic septicemia. In some cases this diagnosis may be correct; probably in a larger number it is an error. Hemorrhagic septicemia, if it occurs at all as an independent disease in the horse, is not certainly distinguishable clinically from other respiratory infections. As a complication of influenza and more frequently of infectious pneumonia it is common. These diseases and their complications have been discussed elsewhere. Bacterins have long been popular as a preventive and to a less extent as a treatment for certain pasteurelloses. Because of the difficulty of determining whether or not the *P. equisepticus* is involved in a given ailment of the horse, until after the animal is dead, "Hem. Sep." bacterins for this animal are difficult to evaluate.

Equine Infectious Bronchitis

1. *Synonyms.* — Contagious cough of horses, epizootic laryngotracheitis.

2. *Geographical Distribution.*—Europe and perhaps elsewhere.

3. *Cause.*—A filterable virus.

4. *General.*—There is some doubt that infectious bronchitis occurs in horses as a separate disease and is not just a mild form of influenza. However, the consensus is that it is a distinct entity due to a specific virus.

5. *Symptoms.*—The disease begins with a rhinitis and a conjunctivitis and the larynx is sensitive to pressure. Two to four days later there is a moderate elevation of temperature lasting only a few hours. At the same time a harsh, dry, somewhat painful cough sets in and there is also swelling of the lymph glands of the throat. The swelling subsides after three or four days but the cough continues two or three weeks. The appetite is normal except on the day that the fever appears.

The infection spreads rapidly and one attack confers about the same degree of immunity as an attack of influenza.

Neglected cases may develop a secondary streptococcic infection which may run a course similar to the secondary infection in influenza.

6. *Treatment.*—These cases require the same care as mild cases of influenza. If protected from cold and insanitary and unhygienic conditions they recover spontaneously.

A CHINESE "TRACTOR"

Mange

1. *Synonyms.*—Scabies, acariasis.

2. *Geographical Distribution.* — Worldwide.

3. *Causes.* — *Sarcoptes scabiei* var. *equi, Psoroptes comunis* var. *equi,* and *Chorioptes equi.*

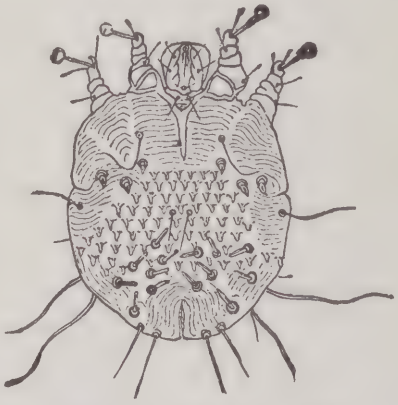
4. *General.*—With the conquest of glanders, mange has become the most serious plague of army animals. A good veterinary service, if given the opportunity, can hold it in complete check and cause little interference with the use of the animals. However, the commander's views of military necessity often render it a difficult disease to handle. It is essentially a disease of debilitated animals — those that are overworked, underfed, and insufficiently groomed. Among such animals it spreads by contact (direct or indirect) with great rapidity and, if unrestrained, will completely disable the animals in a command in a few weeks. It is estimated that a single fertilized female mange mite may have a progeny numbering one and one-half million in 90 days.

No other disease can so quickly incapacitate a whole command of seasoned animals. It is far more serious in winter than in summer and in animals with long coats than in those that are regularly clipped. Filth, a long coat, cold weather, lack of feed, overwork, and debility set the stage for a maximum performance by the mange mite.

There are three types of mange—chorioptic, psoroptic and sarcoptic. Only the latter spreads rapidly or is of serious consequence in military animals. Chorioptic mange is usually confined to the legs; psoroptic mange to the mane and the root of the tail. Both types spread slowly and are amenable to topical treatment. Sarcoptic mange attacks all parts of the body but is likely to appear first in the intermaxillary space and about the ears and eyes.

The sarcoptic mange mites are from 1/100 to 1/50 of an inch in length and, under favorable circumstances, barely visible to the naked eye. Under magnification they are readily identified and differentiated from the psoroptic and chorioptic species. They also attack other animals and man, when in close contact with mangy horses, but soon leave these unnatural hosts. The following discussion refers to sarcoptic mange.

5. *Symptoms.*—The first symptom noted is an itching of invaded areas, becoming more



Sarcoptes scabier var. equi[1]

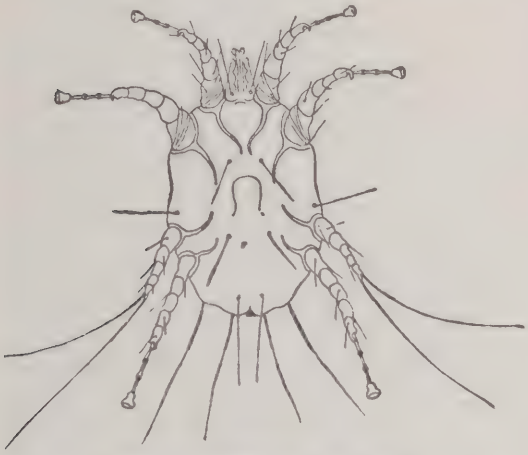
This burrowing mite has spines, scales and bristles on its back and is responsible for sarcoptic mange in solipeds

severe as the infestation advances. Soon the pruritus is so intense that the animal rubs all objects it can reach, bites and kicks continually and may become almost unmanageable. The hair is shed or rubbed off in irregular patches which rapidly coalesce to form large bare areas. This may continue until most of the body is denuded of hair; sometimes within a period of two or three weeks. The skin, at first, reveals vesicles and papules but later becomes greatly thickened, much wrinkled and leathery. Diagnosis is confirmed by finding the mite, its eggs or feces, under the microscope. The search should be made in deep scrapings and even then, in old chronic cases, considerable difficulty may be experienced in finding the parasite. Its feces are much less difficult to find.

6. *Treatment.*—The mange mite is easily

[1] Veterinary Hygiene, *Klimmer.* Courtesy Alexander Eger, Publisher, Chicago.

killed by contact with a wide variety of parasiticides; the eggs are more resistant.



Psorcoptes communis var. equi[1]
Psoroptic scabies among solipeds is caused by this sucking mite

The parasite lives and deposits its eggs in a highly-protected location. It is necessary to repeat most treatments several times, at weekly or more frequent intervals. However, after the second treatment the acute symptoms should be relieved and after two or three weeks the bare spots should start to hair over unless the hairlessness be chronic.

Chorioptes equi[1]
This biting mite causes foot mange among horses

Where it is feasible to dip all the horses in an organization, management of an outbreak of mange presents no difficulty. Either the standard lime and sulphur or the standard arsenic dip is satisfactory, but usually it is not until the outbreak has become severe and has involved a majority of the animals in an organization that they can be evacuated for treatment. This emphasizes the importance of recognizing the disease early when applications by hand or with a spray pump are not too laborious to be carried out thoroughly. Dipping possesses serious drawbacks when the temperature is more than 10 or 15 degrees below freezing; even at freezing temperatures dipped animals require windbreaks for an hour.

Demodex folliculorum, **var.** *equi*[1]
The demodetic mange mite is easily detected on microscopic examination. Here are five stages of the mite, from egg to mature "grub." ***D. folliculorum,*** **var.** ***equi*** **has been described as identical with** ***D. folliculorum,*** **var.** ***hominis***

When mange is discovered early in an attack and only a few animals and but small areas are affected, hand application of parasiticides are preferable to evacuation for treatment. Hand treatment, whatever the extent, is facilitated by clipping but in cold weather, and that is when mange is worst, some objection to clipping may be raised. Hand treatment, except the Russian treatment or those having an oil or grease base, should be applied twice a week or even oftener. Preparations that are effective in the treatment of mange when applied with a sponge or spray pump include:

a. Standard lime and sulphur dip.

b. Standard arsenic dip.

[1] Veterinary Hygiene, *Klimmer.* Courtesy Alexander Eger, Publisher, Chicago.

Debility is both a cause and an effect of parasitism. The vigorous well-fed and well cared for, mature animal is practically immune to the ravages of most internal parasites and possesses a high degree of tolerance to mange mites

c. Lime-sulphur solutions.

d. Vienna tar liniment.

e. Kerosene emulsion and various oily preparations in which some compound of sulphur is incorporated.

f. The Russian or "one day" treatment.

Oily preparations possess the advantage of requiring less frequent application and limiting the spread of the disease where segregation cannot be accomplished. They possess disadvantages in that they cannot be used in hot weather on animals exposed to direct sunshine, nor can they be used on animals exposed to severe cold. Further, they soil stable fixtures, harness, blankets and other equipment used about the treated animal.

In the A.E.F., preference was for a pomade consisting of: Flowers of sulphur two parts, paraffin and sodium carbonate of each one part, and lard or cosmoline seven parts. It was applied generously with a stiff brush, and the excess scraped off the following day. After six days the animal was washed with soap and water. One application was usually sufficient.

"Sulphur lather tablets" is a preparation combining 18% of sulphur in a bland soap, when applied to the body in a lather and left to dry covers the surface with a fine film of sulphur. Its advantages over sulphur ointment are said to be:

(1) Only one-twentieth as much of the emulsion soap is required to cover a given surface as is required of sulphur ointment.

(2) It is less messy than ointment and easily removed.

All hand applications should be preceded by a thorough washing of the part with soap and warm water, using a stiff brush.

Where a dipping vat or gas chamber is not available and hand treatment of mange must be undertaken, no other is so generally satisfactory as the Russian mange treatment developed by Professor Dimianovich. It is carried out in the following manner:

a. Clip the horse, removing all the long hair.

b. Wash thoroughly with soap and warm water to remove scabs.

c. Apply a 60% solution of sodium hyposulphite to the whole body. (It takes one man 30 minutes to apply the solution to one animal.)

d. Allow the horse to dry for about two hours.

e. Next apply a 10% solution of commercial hypdrochloric acid to the whole surface of the body. This also takes one man about 30 minutes.

Both the hyposulphite solution and the hydrochloric solution are best applied with a moderately stiff brush.

f. When the horse is dry the treatment is repeated. In mild cases of mange a cure follows immediately the first two treatments and, after three days, the horse can be washed with soap and water and released from quarantine.

If the mange is very advanced, a third treatment two or three days later is required.

The success of the treatment depends largely on the care with which it is carried out. When the horse is dry after the application of the hyposulphite solution, it is necessary to make sure that the whole body has been treated as judged by the white deposit. Any areas that have been missed must be redressed.

Each dressing takes about three pints of each solution.

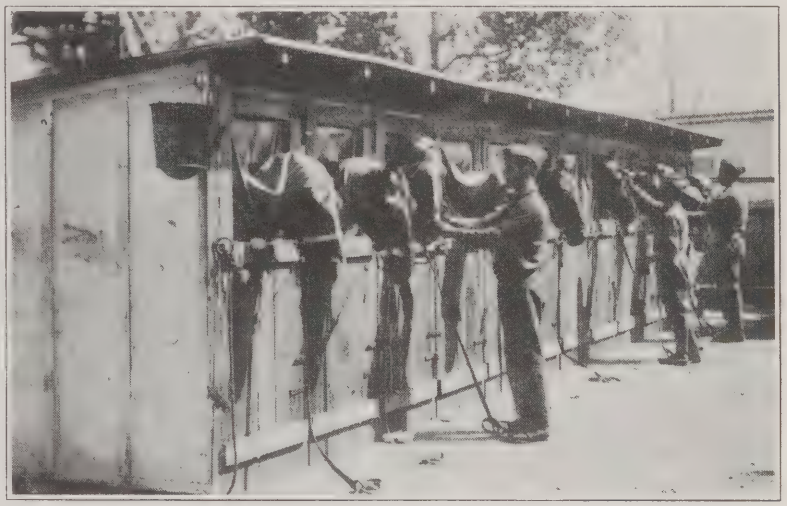
Horses like the treatment and respond to the friction of the skin.

The pruritus disappears the day following the first treatment.

Injury, as a result of the treatment, to

the skin or to the general condition of the animal has not been observed, nor has analysis of the blood or urine shown any change.

The treatment is equally as effective for psoroptic and chorioptic mange as for the sarcoptic variety and for dogs as for solipeds. For demodectic mange in dogs six



A view of the sulphurizing chamber in the veterinary hospital at Neufchateau, France, 1917. Its operation was so satisfactory that, following the Armistice, similar facilities were constructed for each division. The sulphur gas (SO_2) was generated by burning the sulphur of which about one pound per animal is required for a treatment. The animal should be exposed to a high concentration of this gas for approximately one hour. The temperature in the gas chamber should be maintained between 90 and 100°F. — *Vet. Mil. History*

single treatments at three-day intervals are recommended.

Where the skin is hard, hairless, and leathery, raw linseed oil may be rubbed into it once a week to advantage.

7. *Prophylaxis and Control.*—Good horse mastership and diligence in detecting and early segregation of sporadic cases of mange serve to protect a command adequately.

Where the animals are overworked, underfed, and debilitated the task of preventing mange becomes difficult. If, in addition, slightly affected animals must remain at work with their organizations, the problem will try the resourcefulness of the veterinary officer. Rest, when obtainable, liberal feeding, good grooming, clipping, early detection of cases and indefatigable hand treatment must be prosecuted uninterruptedly.

When animals of a command are badly infested, the first opportunity should be grasped to give them complete rest and institute regular dipping, good care and feeding. Whether this is best accomplished by evacuating the animals to a veterinary hospital or building a dipping vat and carrying it out in the organization will, of course, depend upon circumstances. Both time and cost will ordinarily be saved by evacuation to a veterinary hospital, where the treatment will be in the hands of trained personnel.

In cold weather, with no protection available for the animals, mange may be treated successfully by means of gas chambers. This method was much used in the A.E.F. in World War I. The French preferred the gas chamber to the dipping vat as a means of controlling mange.

Recently Gapuz has reported success in the treatment of both sarcoptic and psoroptic mange in carabao and oxen in the Philippine Islands with derris infusion and emulsion of derris in coconut oil.

Treatment of mange must be accompanied by disinfection always. The parasite can live for several weeks on harness, blankets, grooming kits, feedbag, bedding, manger, feed box and all stable fixtures and it can be communicated to other animals by contact with these articles. Any reliable disinfectant is satisfactory for the destruction of mange parasites when off the host. A 5% creosol solution is perhaps the one of choice for the grooming kit and similar articles. Leather should be washed thoroughly with soap and water and then oiled. Stable fixtures are best disinfected by a 1% solution of lye.

Ringworm

1. *Synonyms.*—Trichophytosis, barn itch.

2. *Geographical Distribution.* — Worldwide.

3. *Cause.*—Various species of Trichophyton and Microsporum, parasitic molds.

4. *General.*—At least four species of Trichophyton — *equinum, mentagrophytes, granulosum* and (rarely) *felineum*—are responsible for ringworm in horses. Two species of Microsporum, a genus related to Trichophyton, also may cause the disease.

Ringworm is a mycotic parasitism of minor importance among civilian-owned animals. Among military animals it sometimes spreads with astonishing rapidity. For example, a shipment of horses, in which only one or two appear to have a slight infection when loaded, may arrive at their destination a week later in advanced stages of the disease with great areas of the body surface denuded and raw. This, notwithstanding text-book statements that the incubation period of ringworm is one to four weeks. The explanation probably lies in the wide distribution of Trychophyton spores in the coats of the animals, awaiting only intimate contact, heat, and moisture to set off an explosive growth.

One year in the last decade, ringworm was responsible for more "days lost" by army animals than any other communicable disease. Last year it was fourth in the list, only strangles, influenza and rhinitis (among the infectious diseases) having caused a greater number of days of unserviceability in army animals. Only abrasions and wounds among traumatic ailments caused more lost time. It has existed, in at least one large cavalry post, continuously for several years; 30,000 hand treatments having been given for it in 1941, yet it persisted.

5. *Symptoms.*—The earliest symptom of trichophytosis in areas covered by hair is a small raised area in the coat. When examined, the hair pulls out easily and the skin is inflamed. Soon the infected spot is denuded and covered with a dry crust, which detaches easily leaving a raw surface that oozes serum. In the absence of treatment the affected areas extend at the edges and merge into others. In severe cases a large portion of the surface of the body may be involved. There is little tendency to heal in the center and form a "ring" such as occurs in man, on surfaces not covered by hair and the hairless portions of the skin of an animal. Diagnosis is confirmed on microscopic examination, by finding the fungus (chains of spores) about the roots of hairs and in deep scrapings from the margins of actively affected areas.

The roughened areas of the coat illustrate an early symptom of ringworm. Preceding this stage the areas where the hair stands more erect than normal are small, discrete and numerous

6. *Treatment.*—Ringworm is probably the only condition in the horse, other than tetanus or similar nerve involvement, in which the well being of the animal is not favored by grooming. In ringworm the extension of the infection about the margins of affected areas is hastened by grooming. There is some although not a great deal of danger of infecting animals by the use of combs and brushes that have been used on infected animals.

Long coats afford considerable protection against infection and clipping contributes materially to its extension from animal to animal. Contrarywise, clipping facilitates the treatment of the animal already affected and also materially assists in the early discovery of infection, which is important in its elimination from a command. That is to say, unclipped horses do not acquire the infection as readily as those that are clipped; but having acquired it, the

lesions extend more rapidly and are more difficult to cure in unclipped than in clipped animals.

If facilities are available for dipping, an invasion of ringworm can be eradicated from a command promptly. If hand treatment alone must be relied upon, the eradication of the disease from large commands is difficult, if indeed possible, where the infection is extensive. Infection can, however, be held down to a point where it will cause little or no interference with working the animals.

All Trychophyton species are destroyed readily by any of the disinfectants that will penetrate the coat and scabs. Arsenic dip is, however, more effective than the others. A solution made by dissolving one pound of sodium arsenite in a hundred gallons of water is particularly efficacious since a good deal of the arsenic remains in the coat after the animals are dry and thus limits spread of infection. After several dippings in this solution the hair of the animal becomes so charged with arsenic as to render it for a long period, probably until shed, highly resistant to invasion by ringworm.

One disadvantage of the arsenic dip is the difficulty of properly disposing of it after its purpose has been served. It should not, of course, be discharged into streams nor where it will be washed into streams by rain. It must not be so disposed of, that animals will have access to it then or later, or so that it will contact the foliage of vegetation which the animals may eat.

For hand treatment of ringworm in horses and mules, clipping is extremely desirable, preferably clipping all the body surface and, in any case, an area considerably larger than that apparently infected. This measure alone will frequently result in prompt healing of the lesion. However, disinfectant applications should be used also. Among a wide variety of disinfectants that are effective there is little choice. Probably mercurial ointment USP has no superior. A solution of iodine in glycerin is even more commonly used. Solutions having a high percentage of alcohol, such as tincture of iodine, have the disadvantage of hardening albumen and thus protecting underlying mycelia and spores. Such solutions are less effective on exuding surfaces or on those protected by heavy scabs than aqueous solutions or oily mixtures.

Coming to the surface after an all-in plunge into the dipping vat at Fort Brown, Texas

7. *Prophylaxis and Control.*—Keep military animals away from contact with animals owned by the civilian population and out of stables that have been occupied recently by such animals.

Clip affected animals and avoid contact between them and unaffected animals.

Since animals are infected largely by lying on damp bedding, keeping the animals in dry corrals aids in limiting the spread of the disease. Ringworm is not spread readily by direct contact unless it be very intimate and the coat is wet with urine or sweat.

If the infection is even moderately extensive the probabilities are that practically all animals of the command carry the spores of the Trychophyton in their coats and if circumstances permit all should be dipped three or more times at weekly intervals. Where this is not practical they should be treated by hand application or by spraying all sporadic cases at the first appearance of the disease.

The administration of arsenic internally as a deterrent of tinea seems not to have been reported. It must be looked upon as a drastic measure justified, if successful, only as a last resort and under special circumstances. The use of arsenic as a "conditioner" in horses, charges the hair coat heavily with arsenic. This arsenic remains in the hair permanently and since Trichophyton infection initially grows upon and in the hairs, it might be unable to establish itself in the coat of an animal that had been given a course of arsenic. Of course, with the shedding of the arsenic charged coat, the immunity, if it existed, would be lost. In addition, administering arsenic internally may be detrimental.

In this connection it should be pointed out that there is considerable evidence that the protracted administration of arsenic destroys many of the sweat glands in the skin and may be a cause of "dry coat disease" in horses. Since this condition renders horses practically useless in hot weather, it is, of course, a more serious ailment than ringworm. Hence, the course of arsenic internally, if used at all, should not be prolonged.

This illustrates soldiers of the A.E.F. dipping horses at Rebeval Barracks in France in 1919. This dipping vat was built by the French and later taken over by the Americans. Sulphur was difficult to obtain and a dipping solution of potassium polysulphide and arsenic was substituted for the lime and sulphur solution of choice.—*Veterinary Military History*

Enzootic Paraplegia

The British veterinary service in World War I reported cases of a peculiar paralysis that occurred among the army horses—12 in Egypt and 72 in Mesopotamia. The cause of the ailment was not determined. The extent of the paralysis ranged from single groups to practically all voluntary muscles. The flexors were affected more often than the extensors. All the animals that went down and when helped to their feet were unable to stand, if they were not put in slings, had to be destroyed because of injuries due to struggling. All that could remain on their feet, or that were kept on their feet by slings, recovered.

The most characteristic symptom of the disease was a slowing of the pulse rate, usually to about 26 per minute. In 12 to 48 hours after the first symptom, a rise in temperature to 103 or 104 F. was observed. Recovery required a week to 10 days after the height of the attack was reached.

Periodic Ophthalmia

1. *Synonym.*—Moon blindness.

2. *Geographical Distribution.*—World-wide.

3. *Cause.*—Unknown.

4. *General.*—Periodic or specific ophthalmia developed among horses of the Allies in only three locations—North America, France, and Italy, during World War I. Cases developed in small numbers in widely dis-

Photo by Schlotthauer

Cross section of an eye in a case of periodic ophthalmia, showing chronic destructive lesions. The fundus contained noncoagulable material; the lens has been absorbed and only the capsule remains; the retina has been pushed forward against the lens

tributed remount stations in the United States and Canada. In both France and Italy the areas where cases occurred were definitely limited but within those areas they developed in large numbers.

It is not known that periodic ophthalmia is, or is not a communicable disease. Much evidence has been advanced that it is infectious, an equal amount that is a nutritional ailment—probably a vitamin deficiency. The theory that it is an allergy has considerable support. It may be, like laminitis, essentially a circulatory disturbance due to as undetermined cause or causes. As in laminitis the inflammation occurs within a structure that prevents swelling and causes great injury from pressure.

Medication had little or no effect on the outcome of the disease. Nearly all affected animals eventually became totally blind. This, however, did not interfere greatly with the use of the animals. Most, but not all of them, were allocated to the communications zone in the British service. In the American forces they were largely used in the combat zone. Both American and British veterinary officers (including Major General Sir John Moore) commented upon

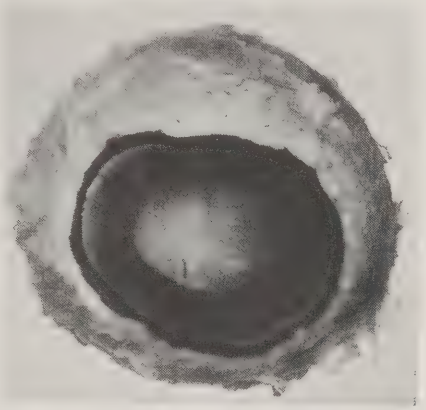


Photo by Schlotthauer

Typical cataract seen in cases of advanced recurrent ophthalmia

the fact that blind horses were usually in better flesh than their mates with normal vision. It is therefore a disease of comparative little importance among military animals.

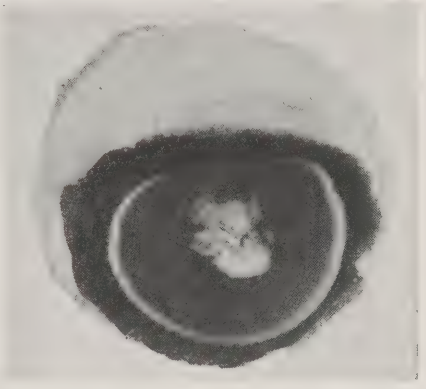


Photo by Schlotthauer

A capsular cataract projecting through the iris

6. *Prophylaxis.*—No method of preventing periodic ophthalmia is known other than moving the animals from localities in which it is indigenous.

Quarantine and Disinfection

1. *Quarantine.*—Quarantine is one of the oldest of the general preventive measures for the protection of the public health. Long before man discovered the causes of communicable disease and the manner of spread, observation and experience had led him to apply the first principle of prevention—isolation of the sick. In the Old Testament there are accounts of crude application of quarantine and isolation of persons afflicted with leprosy. During the years spent in the wilderness, Moses instituted various forms of quarantine. These early procedures were harsh as compared with the modern methods, for they frequently involved banishment from a city or community, and sometimes death for the afflicted. Primitive peoples rather commonly employed the latter means of disease control.

The taboo of a habitation in which a death occurred, had its origin, no doubt, in protection of the living from infections. This is a wide-spread custom of primitive peoples at the present time. Various of the Indian tribes in the southwestern part of this country, for example, abandon promptly, and never enter again, a hogan in which any member of the tribe has died. In effect this taboo amounts to quarantine of the infected premises.

Armies have adopted the same plan of quarantine as recently as the War between the States. In fact it was more recently adopted when General Von Mackensen, on account of the prevalence of typhus among the native population, delayed the advance of his army into Serbia for several months, during World War I.

In 1485, Venice adopted the rule that all vessels coming from infected ports should be detained for a period of 40 days, during which time they must lie in the harbor without intercourse with the land or other vessels. This 40-day period of detention explains the association of the word quarantine with such procedure. Some historians suggest that the time limit adopted by Venice was decided upon as a penance in keeping with the ecclesiastical period of Lent, and for many years "quarantine" meant detention of a person for 40 days.

Quarantine measures have undergone a gradual evolution in the past century, and procedures have become uniform throughout the world. Many changes have been necessary because of the development of knowledge in the sciences of medicine and sanitation, and in the etiology and epidemiology of communicable diseases. International uniformity in procedure has been brought about largely through various international sanitary conferences and the adoption of international sanitary codes by the important maritime nations of the world.

Army regulations provide that all newly-purchased animals on arrival at their first station shall be quarantined for a period of 21 days and that other army animals shall undergo a similar quarantine after a change of station. All infected, suspected and in-contact animals are required to be quarantined whenever there is an outbreak of an infectious disease among the animals of any military command. The length of the quarantine depends on the incubation period of the disease, for the control of which the quarantine is imposed and, of course, upon whether any further cases of the disease developed among the quarantined animals.

2. *Disinfection.*—Disinfection means the removal of infection regardless of how it is brought about. The objective of disinfection is the prevention of disease. Perhaps light, particularly sunlight and drying, rank first in accomplishing disinfection. Biosis, such as putrefaction, fermentation and overcrowding, likewise destroy a vast amount of infection. On the whole these natural processes are far more important than the artificial light and chemical agents used in disinfection for disease control.

However, for the immediate control of given outbreaks of infectious disease the veterinary officer cannot wait for the processes of nature, but must resort to artificial means of destroying infection. In the use of these his success will depend largely upon the selection of agents adapted to the particular purpose and the thoroughness with

which he carries out the process. A hundred percent disinfection is rarely achieved outside the bacteriological laboratory or the surgery, but overcoming mass infection can be accomplished (except perhaps in the case of infected soil) and this incomplete disinfection, alone or in conjunction with biosis is ordinarily adequate.

Disinfectants: Antiseptic, germicide, and disinfectant are terms somewhat loosely used. In a strict sense an antiseptic is an agent that prevents bacterial development (anti = against, sepsis = rotting), a germicide is an agent that kills germs (germ plus caedere = to kill), and a disinfectant is an agent that destroys infection (dis = apart, inficere = to corrupt). As commonly used, there is much overlapping of these terms. Further, various agents fall into two or more of these classifications depending upon the dilution in which they are used, the period during which they may act upon bacteria and other conditions.

Heat may be taken as an example of an agent that falls readily into different classifications. Pathogenic organisms have a narrow range of temperature adaptability. Their optimum range is near the body temperature of the animal affected. Above or below that temperature, growth is slowed and much departure stops it. Anthrax organisms will not grow in temperatures lower than 53 nor higher than 110°F. so temperatures above or below this range may be said to be antiseptic for this particular organism. At a temperature somewhat higher than 110°F., the vegetative form of the organism is destroyed so this temperature is germicidal for that form of the organism. Exposure to a moist temperature of 212°F. for 10 minutes or longer, or to a dry temperature of 375°F. for several hours, destroys anthrax spores and such temperatures are therefore, disinfectants, so far as the *Bacillus anthracis* is concerned. Since the vigor of chemical reactions usually is increased by heat, most chemical disinfectants are more active when warm than when cold, and all, if progressively diluted, lose their power to destroy bacteria, becoming first antiseptics and then innocuous.

Disinfection is logically carried out in three processes — preparation, selection of the disinfectant, and its application, of which the first is the most difficult and most frequently poorly done.

Preparation: The germicidal effect of all disinfectants is lessened, and of some of them completely nullified by the presence of trash, manure, mucous, blood, pus and other organic matter. It is vitally important that such objects be removed, even to scraping the surfaces if necessary. Following such cleaning, the premises should be washed thoroughly with soap and water. Only when no more of the infection can be removed by reasonable mechanical means should the agents to destroy bacteria *in situ* be employed.

Quarantine ward of one of China's ancient temples

The material removed from an infected stall, stable, corral, watering trough, or equipment, etc., should be properly disposed of so as not to constitute a hazard to animals. Fire is the method of choice for disposing of such material. Where it cannot be burned, it may be soaked thoroughly with a very strong disinfectant and fenced so that animals cannot gain access to it.

Selection of the disinfectants: There are a large number of agents that destroy bacteria—heat, light, dehydration and many chemical compounds. The action of disinfectants on organisms varies. Some coagulate the protein (heat, heavy metals), some oxidize it (hydrogen peroxide, potassium permanganate), some enter into combination with it (dyes, sulphur), some dissolve it (alkalies), some dry it by extracting water from it and some act perhaps in other ways.

Some are far more effective against certain organisms than they are against others. Some are dangerous to animals and personnel and some are relatively harmless. Some are active under one set of conditions and comparatively inactive under other conditions. Carbolic acid, for example, is active in warm aqueous solution but is comparatively inactive when cold or in oil. Its disinfectant properties may be increased as much as eight times by raising the temperature only ten degrees. The mercury compounds are neutralized by albumin; alcohol is more effective in a solution of 60% than in stronger solutions, etc. There is no disinfectant universally applicable in disease control, however, among the five most generally applicable are heat, the cresols, lyes (including soaps), certain bactericidal dyes and the halogens; one or more may be found suitable in most conditions.

Heat is dependable if used in sufficient degree. There are various ways of applying it, depending upon circumstances. The gasoline blowtorch affords a convenient means of applying heat to metal surfaces and within limits to wood surfaces. However, the flame must be played upon the surface sufficiently long to raise the temperature to a lethal point for bacteria. Where a railway locomotive is available live steam offers an effective means of applying heat. Its principal use is in disinfecting railway cars. The point of the steam hose, however, must be held close to the surface being disinfected and a steam pressure of at least sixty pounds must be had. Limited areas of soil may be disinfected by soaking with a mixture of equal parts of kerosene and oil and then burning it.

Liquor cresolis compound, in 3 to 5% solution, generally is effective on the interiors of buildings and on corral fences and feedracks and for soaking grooming equipment. It may be applied for short periods to leather with satisfactory results.

Lewis lye, one can (13 ounces) to ten gallons of water, may be substituted for the cresol solution at a saving in cost. Both solutions, contrary to the usual rule, are as effective when cold as when hot.

Metaphen, zephiran, Tanexin, the flavines, etc., are widely useful where refined products are advantageous as in surgery. Iodine as the tincture, or as lugol's solution, is suitable for skin disinfection. Chlorine finds its principal use as a disinfectant for drinking water and for food containers.

IN THE PHILIPPINE ISLANDS

Whatever the disinfectant used, it must be applied liberally and must reach all the surface. In disinfecting buildings and fences, some force, as from a spray pump, to drive the solution into crevices is desirable. With cresol and lye solutions some lime may be used which, when dry, will reveal areas, if any, that have been missed by the disinfectant.

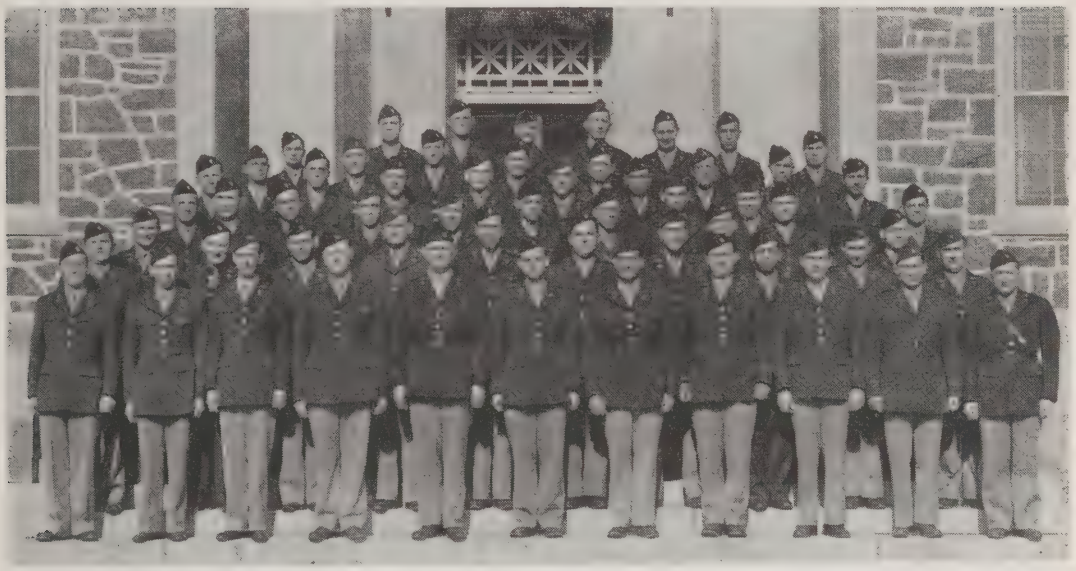
After disinfecting a building, the windows and doors should be opened. The sunlight and ventilation (drying) support the disinfectant and make the building more habitable.

Areas requiring disinfection are, of course, those that may transfer infection to susceptible animals. In the main they include the interior of stables in which infected animals are housed, corrals, picket lines, hitching posts, watering troughs, railway cars, in which diseased animals have been shipped, and stockyards, in which such animals have been confined.

Equipment liable to contamination from infected animals includes saddles, blankets, bridles, halters, harness, horse covers, and grooming kits.

Forage may be contaminated, and ordinarily it is better to destroy it than to attempt to disinfect it; forage and articles of small value may be destroyed on the certificate of the veterinary officer.

VETERINARY OFFICERS' CLASS MEDICAL FIELD SERVICE SCHOOL



Captains Morris E. Blostein, Ernest F. Chastain, Mark Sternfels, Montgomery A. Tegg, Edward E. Thompson, Neil O. Wilson, and 1st Lieutenants John E. Abbott, Bertram V. Allen, Paul C. Bennett, Israel Berkowitz, Richard D. Bertotti, Theodore W. Brown, Clark W. Burch, Lewis I. Case, Maurice J. Court, James M. Cullison, Donald D. Demke, Charles D. Ebertz, Gardner S. Eversole, Edwin N. Foster, Arthur L. Green, Nelson S. Howe, Samuel Hutt, Alfred Kissileff, Leonard Krawitz, and Burt W. Larsen.

1st Lieutenants Frank J. Linn, Kenneth J. McKenzie, George L. McQueen, Joseph R. Massey, Jr., Robert A. Moody, Edward W. Morehouse, Herman L. Moser, Samuel S. Nebb, Karl W. Niemann, Elton V. Parsons, Charles D. Pickett, Donald J. Presler, William G. Raudabaugh, Robert C. Rea, Paul F. Reichert, Bert Reinow, Glenn W. Rieke, Earl C. Ritter, Robert F. Rochfort, Carl J. Schubert, Carl M. Sepponen, Harold A. Servais, Ervin E. Slatter, Walter H. Steele, Karl L. Sutton, Robert J. Veenstra, William F. Waddell, Peter W. Wassenaar, Alvin R. Wingerter, and Donald A. Wright.

THIS picture was taken in front of Hoff Hall—the new academic building at Carlisle Barracks, constructed in 1941.

Since the beginning of 1941 the Medical Field Service School, Carlisle Barracks, Pa., has given to administrative officers of the medical corps, intensive courses in field duties of two months duration. The number in attendance varies from 250 to 400—from 12 to 57 of them being veterinarians. The instruction is mainly purely military which is the same for all groups of officers. However, parts of the course are strictly specialized and are given only to the officers of a particular professional branch—veterinary, dental or medical.

Carlisle Barracks is one of the oldest military posts in the country. It was established by the British during the French and Indian War, about the middle of the 18th century. In the Revolutionary War, the Continental Army used the post as a supply depot. Hessian prisoners of war built the stone guardhouse which is now in use as a post office for the school. The post was used by the Cavalry in the Civil War, and was the most northern point reached by the Confederate Army at which time it was almost completely destroyed. However, it later became the country's first artillery post.

In 1875 this location became the site of the first non-reservation Indian School—Carlisle.

By order of the Secretary of War in 1920, the Barracks was assigned permanently to the Medical Department of the Army.

Experiences in an Army Veterinary General Hospital

THE 30th Veterinary General Hospital was activated at Fort Bliss, Texas, June 1, 1941, with eight officers and four noncommissioned officers. I joined the organization two weeks later and a month after that the executive officer of the hospital, Major Fred B. Green, died, and the commissioned staff was again reduced to eight officers.

July 27, 118 enlisted personnel were received from the Medical Replacement Center, Camp Grant. All but two were from the Selective Service, about half originating in Chicago, and the remainder chiefly from North Dakota, Montana, Minnesota, Wisconsin, Missouri, and down-state Illinois. In schooling they varied, from one graduate each from a college of physical education, the University of Minnesota, University of Wisconsin, and University of Chicago (the latter with a master's degree), to some who had not completed the eighth grade in rural schools. The Chicago contingent included members of several of the skilled trades, sign painter, electrician, steel worker, mechanic, carpenter, cabinet maker, mason, welder, cook, etc., and two professional musicians, one an orchestra leader of national reputation. The rural contingent comprised chiefly farmers and stockmen, a few truck drivers, three horse trainers, a sawyer from the state of Washington, a mountain man from West Virginia, etc. Among them they could speak, besides English, most of the important languages of Europe and two Indian tongues.

Eight days after the enlisted men from Camp Grant joined the hospital, the organization left Fort Bliss for the Louisiana Maneuvers in a motor convoy 73 miles long and containing more than 1200 vehicles. It took two days to cross the desert and three more to reach De Quincy, Louisiana, where

BUILDINGS OF THE 30TH VETERINARY GENERAL HOSPITAL, FORT BLISS

This view of buildings of the 30th Veterinary General Hospital is taken looking due north. The buildings shown include (left to right): the Recreation Building, the West Barracks, the East Barracks, the Administration Building, and the Mess Hall at the extreme right. Five 30-stall ward buildings (surgery in each) and a third barracks building are not shown

the hospital was set up for the treatment of animal casualties. There was considerable discomfort in spending early August days under a blazing desert sun, traveling at what seemed like a snail's pace but we hadn't been in the swamps long till we would have traded our equity in the whole of the state of Louisiana for a few square miles of that desert and a chance to get our clothing and bedding dry.

The veterinary general hospital is the largest installation in the army veterinary service, comprising, according to the tables of organization, 269 enlisted men and 11 officers. When set up fairly compactly it occupies an area of about 30 acres. It is located far enough to the rear of the combat zone to be unaffected by temporary advances and withdrawals of the front line. The plan for its operation contemplates that it will be housed in buildings constructed for that purpose and will not move so long as the army which it serves remains in the same sector. For a field veterinary unit it has extensive equipment and it is expected that the standard of veterinary medicine and veterinary surgical practice in it will be equal to the best to be found anywhere.

The 30th Veterinary General Hospital did not meet all of the standards laid down for such an organization. Because it was oper-

[1] From an address by D. M. Campbell, Chicago, at a National Defense meeting of the Keystone Veterinary Medical Association, Philadelphia, April 29, 1942.

OFFICERS OF THE 30TH VETERINARY GENERAL HOSPITAL, FORT BLISS, TEXAS

Seated, left to right—Capt. Joseph F. Neiberding, Major Fred Green, Lieut. Col. D. M. Campbell, Capt. Tom Evans, Lieut. Louis B. Bate. Standing, left to right—Lieuts. H. B. Brown, John A. Utterback, G. C. Coburn, and John P. Denton. (Photo taken before the commissioned personnel was complete)

ating in maneuvers and not battle conditions and was going to close after only about 50 days, buildings were not constructed; the personnel lived in tents and patients were kept on picket lines. Since it was organized for training purposes only and, at that time, participation in maneuvers was not contemplated, it was far under strength in enlisted personnel. Further the hospital and many other rearward installations were located much nearer to the zone of action than probably would be the case in actual warfare—at no time more than 100 miles from the "front line." This necessitated moving the hospital three times as the fortunes of the combat troops varied. It also made practical the evacuation of animals by trucks, instead of by rail, as would likely be the case, at least in part, under war conditions. Because it had been so recently organized and a large percentage of the enlisted personnel were wholly unfamiliar with the handling of animals it required some time to strike its stride but during the last four or five weeks of its operation, the quality of the medical and surgical service of the hospital and of the animal management was the equal of that to be found anywhere on the continent. Further the clinic was probably larger than any other on the continent; larger perhaps, than the equine clinics of all the veterinary colleges in the country combined. The standards of animal management that prevailed were a model of what such standards should be. The U. S. Department of Agriculture took many reels of motion pictures in the camp to illustrate approved methods of grooming, feeding, watering, shoeing and all other matters of animal management.

RECEIVING LINE 30TH VETERINARY GENERAL HOSPITAL, LOUISIANA MANEUVERS 1941

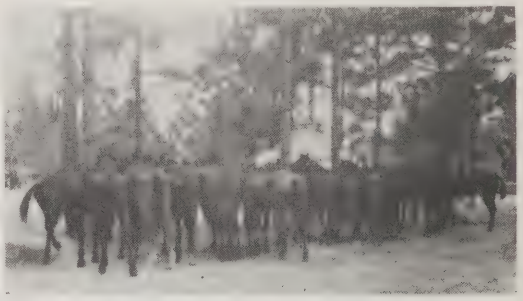
Horses were brought to the hospital during maneuvers in trucks of the type shown in the illustration. The E.V.T.'s and Preston brands were verified, the property checked, and a receipt for the animals given the NCO in charge of the truck. The animals were then examined and distributed among the wards for treatment

Allowing for a beginning with only a few patients and for several days lost due to changes of location, an average of 60 animal casualties was received at the hospital daily. These were moderately severe to very severe cases; grave enough to be evacuated an average of 75 miles for treatment. Some days, or nights rather, for most patients arrived at night, a much larger number was received. One night 173 cases were admitted and the night the hurricane struck the camp, 130 cases were received between 9:30 P.M. and 4:30 A.M. The fact that several tents were blown down during the night and the next morning twelve-quart buckets, sitting about the camp, were found filled with rainwater to within two inches of the top, indicates the kind of a night it was to be treating animals in the open.

Except just after moving and setting up the hospital anew, from 375 to 600 cases were under treatment most of the time. Sometimes the number was larger; when maneuvers ended September 30, there were 754 horses in the hospital. A total of 1905 animal casualties were admitted and 1885 were returned to the organizations from which they came. Of the 20 cases that were lost, three died in the hospital and 17 were destroyed, as incurable, or not worth shipping back to Fort Bliss, or because of their ailments, were non-transportable cases when the maneuvers ended.

A veterinary general hospital operates almost continuously day and night, during active phases of the operations up ahead of it. The personnel, perhaps, worked the longest hours of any group on the maneuvers. This was well expressed in conversation overheard among several soldiers busily grooming horses. One said, "Say Bill! What day is this, Sunday or Monday?" Bill, after some hesitation, replied, "I'm not sure but I think it's Tuesday, maybe Wednesday." Another chimed in, "Aw hell! What's the difference? It just gets light, then gets dark, then gets light again."

About 10 days after maneuvers began,



"DUTY LINE" AT THE 30TH VETERINARY GENERAL HOSPITAL

Each morning during maneuvers all animals fit for duty were selected by ward officers from those in the hospital and tied on the "discharge" picket line of the Receiving and Evacuation Section. Here each animal was given a careful physical examination, first by the officer in charge of the section and second by the Executive Officer or by the Commanding Officer, and if passed as sound was turned over to the Remount Service to be returned to the organization to which it belonged. Animals to be discharged must (1) have recovered from the disability for which they were under treatment, (2) be free of any other disability, (3) be fit for full duty (conditioned if they had been in the hospital more than 10 days), (4) be properly shod and (5) possess a serviceable feed bag and halter and be faultlessly groomed

Major Austin T. Getz was assigned to the hospital as replacement for Major Green, deceased. A medical officer and medical enlisted personnel also were assigned to the hospital at about this time. Four additional veterinary officers were assigned to the organization for periods of two to four days. The acute shortage was always in enlisted personnel. Notwithstanding the men worked hard and very long hours, the discipline of the organization was highly commendable. There were no desertions, only one AWOL and that for only one day, no cases of venereal disease and no trials by courts-martial.

Three conditions met with on maneuvers —nail pricks, exhaustion and laminitis, and contused wounds of the back and withers— possess features that seem to be of considerable interest. The treatment used in these conditions is indicated in a general way in the following discussion.

Treatment of Foot Injuries

"Foot cases" are responsible for an enormous wastage of army animals. On the Western Front in World War I, foot injuries, chiefly nail punctures, averaged 400 cases a week in the British army in 1916 and 1917 and later reached a height of 800 cases weekly. These astonishing numbers include only cases admitted to the veterinary general hospitals, i.e., cases severe enough to justify evacuating some 200 miles and requiring treatment for a period of at least two weeks. Statistics for the A.E.F. are not available but from the testimony of American veterinary officers who served in France, one judges that "picked up" nails were as common among our animals as they were in the British forces.

The great prevalence of nail punctures among American and British animals was due in part to the type of field kitchen (rolling kitchen) then used, but since discarded. Meals were cooked as the organization moved, broken up packing cases being used for fuel. The nails were not removed before the wood was burned and when the ashes were dropped along the roads they became heavily seeded with nails. Although such practices do not obtain at army posts in peace time, and notwithstanding much effort has been expended in picking up scattered nails at all American army posts during recent years, nail punctures are still a frequent cause of ineffectiveness in our army animals. During the year ending June 30th, 1941, more than a thousand cases occurred, resulting in nearly 15,000 days of idleness, although the mean animal strength of the Army was then only 25,000. That year nail pricks ranked fifth in importance among external injuries to army animals.

Picket lines at the Calcasieu camp

The "foot cases" reaching the 30th Veterinary General Hospital during the Louisiana maneuvers numbered in the hundreds, affording an opportunity to observe the results of different methods of treatment in many parallel cases. This observation led to the conclusion that the treatment of wounds of the feet can be characterized in many instances as "too much and too late." It also soon led to the general plan of treatment of nail punctures described in the following. It is in major aspects a method of handling these cases advocated some two or three years ago by Mitchell of Edinburgh, Scotland.

It is rare that a nail entering the sole of the foot carries infection beyond the surface

Left to right: the Medical Dispensary and ambulance; a corner of the Junior Officers' tent, the Executive Officer's tent, and the Commanding Officer's tent. The picket lines were in the rear of these tents

layer of the sensitive sole. Any attempt to follow the tract of a fresh nail puncture with a hypodermic needle, and inject iodine or other disinfectant into it is extremely ill advised. To open the tract with currette, probe, or scalpel is still more undesirable. A more common error is to delay treatment because of difficulty in locating the site of puncture until infection has developed and

AT WATERING TIME

Watering the animals is a heavy chore in an army veterinary hospital. Even if water is available at the hospital site most of the animals will have to be led 100 yards or farther and since, in the summer climate of Louisiana, they require watering at least four times daily it may require up to 200 man hours each day when the number of animals in the hospital reaches six or seven hundred. Watering is facilitated if 20 to 30 animals can be watered simultaneously. To accomplish this the tank illustrated was built of canvas. The water for this tank was hauled 10 miles and 5000 to 8000 gallons was required daily—seven to twelve trips for a tank truck. Hauling this amount of water required the full time of two men from 4:00 a.m. to 9:30 p.m.

perhaps suppuration has occurred. This is a common result of relying too much upon hoof testers to locate the wound.

Since relatively few nails penetrate the frog the overwhelming majority of nail pricks will be found in that portion of the foot lying between the frog and the shoe. When a nail penetrates the horny scale and enters the sensitive tissues the animal invariably goes lame and the rider or driver should, and usually does, recognize that the animal is injured. Ordinarily the rider will make some search for the nail and in most instances, find and remove it. He may attempt to pour turpentine, iodine, or other panacea into the hole left by the nail. Since the wound in the soft tissues closes as the nail is withdrawn this in itself does no harm. However, after the nail is removed the animal walks better than before, his rider may conclude the turpentine has cured the injury, and continue to work the horse. Thus the veterinary officer may not learn of the injury till the next morning, or later, when the lameness reappears in a more severe form than before. By this time the most propitious period for treatment has passed.

When a horse, or a mule with a recently punctured injury of the foot, is brought to the veterinary officer for treatment he is usually confronted with a task of some difficulty in locating the wound. If the injury is from a horse shoe nail driven too deep, or if the injury is in the frog, or if pus has already collected between the sensitive and insensitive sole, locating it may not be difficult and he may be able to find it without removing the shoe. However, locating a puncture in the sole often may be extremely difficult and time consuming unless the shoe is removed. Further proper treatment, except trivial cases, cannot be accomplished without this being done. Therefore, removal of the shoe as a first step in the treatment should be routine.

After the shoe is removed the foot should be washed thoroughly; using soap and water and a stiff brush; then inspected carefully. If the puncture occurred more than an hour previous to the examination it is unlikely that it can be seen by such inspection. The next step is to pare off the rough surface of the sole. Following the rough trimming, if the wound is not easily detected, the entire surface of the sole should be searched systematically with hoof testers for sensitive areas (sometimes there is more than one nail-prick). When a point is found where the animal flinches on pressure it should be returned to several times, after testing other areas. With the sensitive area definitely located, careful paring of the whole surface of the sole is continued until it will spring under strong pressure from the thumb. The wall should not be lowered during this process. When the sole is uniformly thin and clean, careful search in the sensitive area should reveal a small spot where the grain of the horn is broken,

and instead of the pared surface being smooth and slick an area one-sixteenth to one-eighth inch in diameter will appear slightly fuzzy. This marks the tract of the nail.

An area about an inch in diameter, with the puncture in the center, should be thinned further as much as possible without causing hemorrhage. Of course if suppuration has already occurred it will have been discovered before this, but assuming the puncture is not more than 48 hours old, the next step is to remove a small disc of the remaining horny sole. It should not be more than three-eighths inch in diameter, the puncture wound being in the center. This removal needs to be skillfully and painstakingly accomplished with a sharp-pointed bistoury. Hemorrhage should be avoided for if it occurs the operation will be delayed until it can be completely arrested.

Removal of this disc of horny sole will uncover the infective material in the wound. In traversing the horny sole the nail pushes ahead of it some foreign material—dirt, perhaps broken bits of the outer sole or flakes of rust. When the nail strikes the sensitive sole the latter springs away from the horny sole and the foreign material is pushed aside between the two soles. Passing on into the sensitive tissues the nail carries a minimum of infection—an amount which these tissues that have an extremely rich blood supply and great reparative powers, in most instances, can overcome readily.

In untreated cases it is at the point where the wound enters the sensitive tissue that the abscess forms. In the treatment of these wounds one often finds considerable quantities of pus (a half dram or more) and the animal in great pain, yet when the pus is evacuated the sensitive sole may show no injury. If the case be not treated, if drainage is not established from below, the infection is forced along the injured tissue in the tract of the nail and ultimately discharges above the coronet, commonly resulting in quittor or the formation of a fistula at the heel. No veterinary officer should boast of the number of successful quittor operations he has performed because, with few exceptions, each is a signboard pointing to an improperly treated nail prick or corn.

With the site of infection exposed any visible foreign matter is removed and the area thoroughly irrigated with a normal saline or other nonirritant solution. Then the area is dried and dusted lightly with sulfanilamide and covered with a pad of gauze about two inches in diameter and folded six or eight thicknesses. A dilute solution of alum is as satisfactory as any with which to moisten the gauze. Since it is essential that this dressing be nonirritant of course iodine is eliminated. If infection has already developed at the site of penetration more sulfanilamide should be used. The gauze should be covered with dry cotton and the cotton in turn covered with oakum dipped in pine tar and plastered down evenly and smoothly. The purpose being to form a water-tight seal for the protection of the wound. If tar is not available heavy cup grease is a fairly satisfactory substitute.

The shoe is then replaced and the dressing held in place by a metal strip, the ends of which are forced between the shoe and

the sole. A section of metal barrel hoop makes a good retainer for this purpose. Further careful packing with dry oakum can render the dressing very secure. In most instances the animal will travel sound and may be returned to duty within four days, the dressing being left in place until it wears off. If the horse is still lame at the end of a week the dressing should be removed and the wound examined. If there is no suppuration a new dressing should be applied, but if suppuration has developed it should be treated as described later for abscesses in this location. In cases treated before there is a collection of pus between the two soles, suppuration is rare.

Where the nail has penetrated the plantar aponeurosis, or possibly even impinged upon the navicular bone, the lameness may persist for as long as four weeks and then disappear suddenly without having had any external evidence of infection. If the wound does not clear up in a month an operation following the course of the nail injury to its terminus is indicated and is usually entirely successful. The operation should not be delayed longer since atrophy begins in the hind leg after about five weeks of nonuse. Recovery from atrophy of the gluteal and femoral muscles may require many weeks.

In cases where treatment has been delayed until an abscess has formed and the animal is in great pain and refuses to bear any weight on the limb, the routine of treatment is much the same. In paring away the insensitive sole, all that has become separated from the matrix, i.e., undermined with pus, must be removed, and in the cases treated early, the margin of the opening in the insensitive sole must be reduced to paper thinness. If this margin be left thick and unyielding, regeneration of horny sole is delayed. If any part that has been separatd from the keratogenous membrane is allowed to remain suppuration will continue under it, or rather over it.

In dressing the wound where suppuration is active a considerable amount of sulfanilamide is packed into it before the gauze is applied, otherwise the routine is that already described, except that the dressing should be removed after a week and a new one applied. The dressing should be changed sooner if the lameness increases markedly or the temperature rises sharply. Chronic cases where the pus has burrowed high into the tissues of the foot require daily dressing for four to five days or longer.

Usually where the pus is limited to the space between the sensitive and horny soles and not more than one-third of the sole is removed nail puncture cases may be returned to duty in two weeks. The foot should be shod with a light metal or heavy leather pad covering the whole sole. Space between the pad and the sole is packed with tarred oakum. If a metal pad is used a V-shaped notch should be cut into it to expose the frog.

The treatment throughout should be conducted with the same regard for asepsis as would be observed in treatment of any other wound or in performing an operation elsewhere on the body. There is no more occasion to use irritant disinfectants in nail pricks than in other wounds. Turpentine, powdered copper-sulphate, pure phenol and other irritants have no more place here than in a wire cut. They delay recovery for days or weeks. Frequent changes of the dressing are rarely necessary and if unnecessary are objectionable. The case should be treated thoroughly and painstakingly the first time and let alone thereafter unless by the nature of the wound or the increasing discomfort of the animal, redressing is definitely indicated.

NINETEEN CASES OF LAMINITIS

All these animals were received in a single night. About half of them were affected in all four feet. The photograph was difficult to get since several of the animals could not be induced to stand longer than a minute. Two horses it will be noted could not be kept on their feet even for this period and after several trials had to be photographed lying down

Exhaustion and Laminitis

The animals employed in the maneuvers arrived in Louisiana during hot humid weather that followed a long period of daily rains. At Fort Bliss, they had experienced hot burning sunshine at an elevation of 4000 feet and an exceedingly dry atmosphere. In Louisiana, the elevation was less than 100 feet and the humidity always above 90% and compared with conditions on the desert there was little bright sunshine although, except for one week during maneuvers, the weather was rather dry. The nights as well as the days were warm.

The striking fact in connection with the cases of heat-exhaustion that developed in Louisiana, was their extreme severity during early phases of the maneuvers and the gradual fairly uniform decrease in severity as the maneuvers progressed and presumably the animals became better acclimatized.

Heat-exhaustion is prone to have a number of complications — laminitis, delirium and convulsions, synovitis, nephritis and muscular soreness being the most common. Laminitis as a complication of heat-exhaustion is a fairly accurate measurement of the severity of the attack—the more severe the heat-exhaustion—the higher the percentage that develops laminitis. On this basis the greater severity of the cases of heat-exhaustion early in the maneuvers is strikingly apparent. Of the first 31 cases of heat-exhaustion 30 developed laminitis. Of the next 70 cases 30 developed laminitis and of the remaining 145 cases, only 17 developed the disease. The severity of the cases of laminitis varied with their frequency. Of the first 18 cases 12 were affected in all four feet and eight of these were eventually destroyed (several of the animals suffered from other complications also). Of the next 40 cases only five had quadripedal laminitis and one had to be destroyed. Of the remaining 20 cases the inflammation was confined to the front feet and all recovered.

Of the first hundred cases of exhaustion to be admitted to the hospital, all were cases of heat-exhaustion—i.e., mineral depletion owing to excessive perspiration. The last hundred cases were quite different. They were mainly cases of exhaustion due to debility—just an end result of overwork, underfeeding, neglect and lack of rest. The remaining 66 cases coming between the first hundred and the last hundred included both types of cases.

Our treatment for exhaustion was simple, albeit, laborious. Cases of every degree of severity reached the hospital. Some were

already improving and would undoubtedly have recovered without any treatment other than rest and shade. Such cases were few. From them the range extended to the most severe—cases that seemed to have not half-a-dozen hours to live. In fact, 64 cases of

TYPICAL ATTITUDE ON THE SECOND DAY OF AN ATTACK OF LAMINITIS

This animal was a victim of exhaustion about noon, and evacuated to the hospital during the night. It was severely affected with laminitis when unloaded and was given a 10% saline injection immediately and another early next morning. On admission the feet were packed in ice, which had melted, but the sacks it will be noted had not yet been removed when the photograph was taken

exhaustion died before they could be evacuated to the hospital and some while being transported. All cases that reached the hospital were treated, whatever their condition, and none died of the primary ailment. The mild cases were returned to duty routinely on the fourth day. At that time they did not pant or blow more than normal when exercised. The severe cases (not complicated by laminitis) or those in which the laminitis cleared up in three to four days, were returned to duty within two weeks; a smaller number required twice this period for recovery and as will be seen nine cases were destroyed because of complications. Thus approximately 90% of the cases of laminitis recovered and more than 97% of the cases of heat-exhaustion were returned to their organizations as serviceable animals.

Immediately a case of exhaustion was unloaded it was given intravenously 1000cc (if mild) to 1500cc (if severe) of a 10% salt solution. In the majority of the severe cases no pulse could be detected and in at least 25% of them only thick dark blood could be made to flow in drops from a large calibre needle inserted into the jugular vein. Within 15 minutes and sometimes by the time the intravenous injection was completed these animals would walk to the watering tank and drink gallons and gallons of water; within a half hour they would drink as much more and then many of them would eat hay immediately. The improvement in the circulation was extremely rapid. Those that would not eat, were given a second intravenous injection after an hour, and a third two hours later. A few cases were given five injections within 24 hours. A good many that had only the two injections and that looked all right the following morning would commence blowing in the afternoon when the day became really hot and then would be given a third injection.

More than 50 of these cases of exhaustion were suffering from laminitis when they were unloaded at the hospital. Half as many more developed this condition within 12 hours after reaching the hospital. None developed laminitis more than 12 hours after being treated for exhaustion. The majority of the cases of laminitis were extremely severe when they were unloaded. A smaller number were mild but all were worse within 24 hours. The cases complicated by laminitis received the saline injections the same as the others, but since they were the more severe cases most of them received as many as three injections (4500cc in all) of a 10% saline solution. Since about one-fourth of them could not walk and some could not even stand, water had to be carried to them and thus it was noted they sometimes drank up to 15 gallons in the first hour after reaching the hospital.

The feet of these laminitis cases were packed in ice immediately after the first saline injection was completed; about 10 pounds of ice being used for each foot. This treatment was not repeated but the next

day and every day thereafter, forced, but gentle, exercise was given. Even if the animal required help to stand it was forced to its feet and with one man on each side, one in front and one behind, it was helped along for a matter of 50 feet, three or four times daily. Those that could be led received about 10 minutes exercise as often—oftener if the walking was not too painful. Animals that had laminitis were not tied but turned loose in the fair pasturage available and encouraged as much as possible to take voluntary exercise.

In evaluating this treatment it would appear that the 10% saline injection (sodium chloride 4%, sodium bicarbonate 5%, potassium chloride 0.5% and magnesium chloride 0.5%) must be given the place of first importance. It removed or overcame the cause of the condition. The frequent periods of gentle exercise, however, must be given a good deal of credit. The opportunity was afforded recently of observing about a dozen only moderately severe cases of laminitis treated routinely and placed in a concrete soaking vat several hours daily. All developed dropped sole and were destroyed. It is not possible to say if the application of ice to the feet was curative. On one occasion when the supply of ice was insufficient in some eight or ten cases only one foot was packed in ice, the other constituting a sort of control. There was no difference in the course of the disease in the feet that were and those that were not packed in ice. However the ice treatment was well worth while for the relief it gave the animals. It is a humane measure that should in no case be neglected. Perhaps the salt ration given the animals after the acute attack of exhaustion had subsided would not be considered a part of the treatment, however it was an important part of the aftercare. They were given all the salt they wanted and at first would fill their mouths and eat it as a hungry horse does oats or shelled corn. They consumed up to three pounds each during the first four days in the hospital but thereafter only a normal amount.

A good type army remount

Courtesy Horse and Mule Association

Sunday morning riders

Summarizing the cases of laminitis: Of the 78 cases more than half of the whole number were of more than average severity; at least one-fourth were extremely severe. 69 recovered and nine were destroyed, because (1) the attack appeared to be incurable, (2) other complications, (3) the animals were of small value and their recovery doubtful, and in all cases to prevent further suffering. Of the nine destroyed, all had quadripedal laminitis. Three suffered from acute nephritis of an intractable type. Two developed a spastic paralysis that resisted treatment and one suffered from severe injuries about the head from running into trees during delirium. Two probably would have recovered without deformity of the feet but being undersized, of poor conformation and somewhat aged, the prospect was not deemed worth the expense of treatment and later shipment to Fort Bliss.

A majority of these nine cases developed severe, extensive decubital sores, in spite of the fact they were turned over frequently during daylight hours — an indication that to avoid decubital sores in animals that are down continuously they must be attended both day and night.

Contused Injuries of the Back

Of contusions, and abscesses of the back and withers there were 366 cases or 19% of the total admissions during maneuvers. Although these injuries constituted about one-fifth of the cases admitted, they were responsible for a large proportion of the animal patient days; possibly more than 80%.

The policy was adopted of treating all of these "back cases," regardless of their apparent severity, on the ground that the outcome of such injuries is, to a considerable degree, unpredictable. The results of the treatment supported this policy. At least it demonstrated that an accurate prognosis could not always be made since some cases that looked nearly hopeless made good recoveries and others that certainly appeared no more severe took months to recover. The percentage of unpredictable cases was not large but the number was sufficient to justify treatment of all cases, for at least 30 days, before condemning the animal.

Veterinary officers must never lose sight of the fact that the primary function of the medical man is to cure. It doesn't require a college course to aim an automatic. Killing animals is a confession of failure.

BACK CASES

Upper left: Typical contused wound of the withers. Many such injuries were incurred by the cavalry horses during the Louisiana maneuvers. They occurred most frequently about the withers but were common on the ribs and beneath the cantle

Lower left: Showing the skin incisions. Note the incisions do not go to the top of the withers. Uninjured tissue at the top limits movement of the parts. Movement of a properly treated wound at this location is the chief deterrent of rapid healing, hence the incisions are made as low as the nature of the injury will permit and only injured tissue is removed. Often even when the swelling is great very little tissue requires excising. The protective towels used during the operation have been removed to permit better photographing of the area

Upper right: Anesthizing the surgical field. Note the large area that is shaved and disinfected. These operations were rendered practically completely painless by the use of novocaine. For an operation of this magnitude about 100cc of the solution was required. None was injected into tissues that would later be invaded by the scalpel. The surgeon is Lieut. John A. Utterback

Lower right: An operation on a particularly serious case. Wounds of this width require a long period to heal. Although the swelling in this case was only moderate the surgeon found much injured tissue which required the excision of a wide strip of skin and underlying structures. Continuing the incision to the midline on the withers also is objectionable and to be avoided whenever possible

Veterinary officers accomplish far more by prevention than by therapy but the opportunity to practice preventive medicine is dependent upon the ability to practice curative medicine successfully, and opportunities for the latter must not be neglected or the chance at the former will be lost. Public opinion exists in the army about as it does in civil life and is about as determinative. The reputations of veterinarians, in or out of the army, depend more on the few ailing animals that they cure than upon the many that they prevent from becoming ill. The Medical Corps gives every ailing soldier his chance, regardless of the prognosis, and while the Veterinary Corps cannot justify the waste of government funds on hopeless cases, neither can it afford the reputation of being quick on the trigger.

In general the treatment of contusions and abscesses of the back and withers comprised an immediate operation carried out under the best aseptic technique we were able to contrive, protection of the wound from contamination for 48 hours and then exposing it to the air and particularly to sunshine. The operative wound was packed with sulfanilamide at the time of the operation and thereafter dusted with it until the discharge had practically ceased. In most cases this required about a week, but the discharge was never profuse. At the time of the operation, or sooner if the opportunity offered, the animal was given therapeutic doses of sulfanilamide which was continued for a week.

The value of meticulous aseptic precautions in operations performed in the open might be questioned and even more the importance of such measures when the operation included evacuating enormous abscesses filled with pus. Experience seemed to demonstrate that the best asepsis obtainable is worth while under such conditions. There was no dust blowing about where the operations were performed. The surgeons wore rubber gloves and clean white suits and changed them frequently enough to keep them clean, often this meant several times daily. Large areas about the site of operation were shaved and cleaned as thoroughly as possible and in addition clean towels were used right up to the edge of the wound. The best anesthesia obtainable was employed. In most instances it could be described as perfect, or at least as satisfactory. The operations were performed rapidly and there was a minimum exposure of invaded tissues to the air, which is important. Exposure of operative wounds after a couple of days not only did no harm but appeared to hasten the healing process. Exposure of freshly incised tissues, even for an hour, appeared to be harmful and to delay healing, probably through coagulation of lymph and dehydration of tissue, or the opposite, the absorption of liquids by the cells that thus become edematous. Probably both conditions occur in different parts of the same wound and delay repair. And finally a good deal of credit must be

CONTUSED WOUNDS OF THE WITHERS

No two cases are alike. The one shown at the top may not be particularly serious although there is much swelling. When the serum is evacuated and the swelling subsides it may be found that the skin injuries are superficial and that none of the tissues underneath are so badly injured as to require removal. The case shown below may be quite severe; the injury being in the nature of a sitfast extending possibly as much as two inches into the underlying tissues. The emaciated condition of the animal, the engorged superficial veins and the desiccated appearance of the abraded surface warn the surgeon against any rosy prognosis

given to the local and general action of sulfanilamide in keeping down suppuration —thus promoting healing, and most important of all, keeping at a minimum the formation of scar tissue. Nothing is gained in the healing of an injury to the back of a cavalry horse if the contour of the back is not normal after the injury is healed, or if any large plugs of scar tissue remain. Such backs just won't stand the abuse that a saddle gives them in the army.

For the observance of asepsis in treating infected wounds it can be said that the pus from unopened abscesses is not always the mass of infection it appears to be. It may contain very few organisms, and in any case very few species of organisms. Further, the surrounding tissues may be presumed to have acquired considerable resistance to such organisms as are present in the wound. It seems highly important not to add a mass of new infection with which the tissues will have to contend. If, in spite of one's best efforts, a small amount of new infection is added to the wound the noxious insult to the tissues is not as great as from gross contamination, and the packing with sulfanilamide and the internal administration of the drug constitute a sort of redeeming apology.

Of the 366 cases of injured backs treated, some were returned to their organizations before recovery. These belonged to those organizations leaving the maneuver area for various stations other than Fort Bliss. An effort was made to follow up the more severe cases, and so far as was learned only two of those animals were destroyed because their further usefulness seemed unlikely, two required a second operation and 24 were returned to duty after an average of 55 days on sick report at their home stations.

Of the 17 cases of injured back that remained with the 30th Veterinary General Hospital at the end of the year, (three months after maneuvers) eight required a second operation. All gave promise of making complete recoveries ultimately. The treatment of those in the hospital after four months possibly was not justified by the outcome but, at the time treatment was commenced, they could not be picked out from among the larger number of similar cases that recovered in 60 to 90 days. Only 37 of the 366 cases required treatment for more than 100 days.

It can be said definitely that animals in fair condition recovered more promptly than those injured near the end of the maneuvers when they were debilitated and reduced to "skin and bones." However this may not have been due entirely to lack of recuperative power as animals in poor flesh are always more easily and perhaps more severely injured by saddle pressure than those in normal condition.

It was observed that these injured backs improved faster at the DeQuincy and Merryville locations than they did at the Calcasieu camp. At the two former locations the wounds were exposed to sunshine a few hours daily; the animals being kept in light shade where there were many areas of sunshine but at the Calcasieu camp no sunshine whatever penetrated the dense shade. Further, the weather was mostly dry at the sunny camps and it rained every day and most of the nights while the hospital was located on the Calcasieu River. The animals were noticeably better contented when in the sunshine part of the time and more restless and bellicose when in the deep shade all of the time. This did not apply to cases of exhaustion. They did badly in the sunshine; much better in the shade.

Mangers contrived from strips of 30-inch chicken wire netting, tied together at the bottom with bailing wire and fastened to poles at the top saved much labor and conserved hay. Mangers made from salvaged canvas supported by chains were even better since they saved the grass seeds and further made the use of feed bags unnecessary

Treatment of Wounds in Army Animals*

THE treatment of wounds constitutes a large part of the veterinary officer's service with animals. In the report of the Surgeon General of the Army for the year ending June 30, 1941, admissions to the veterinary sick and wounded register as a result of "violent and accidental causes" exceed those for all other causes combined; their number being 13,214. These injuries were responsible for 244,227 days lost. Ninety-five percent of these ailments and 96% of the days lost were due to injuries of the nature of wounds or contusions. This is equivalent to one injury, serious enough to put the animal on sick report, for each two animals in the army and to 9⅛ days on sick report for each of the 25,000 animals possessed by the army in 1941. If all traumatic injuries in which there was no break in the integument are eliminated from these totals there are still left 8,761 open wounds and 162,000 days lost from service because of them, or the equivalent of one horse or mule in three wounded and 6½ days lost for each animal in the army. This takes no account of the many traumatisms that required incision in the course of treatment and thus became open wounds.

Although the foregoing illustrates the great opportunity that the veterinary officer has to conserve the animal strength of the army by skillful treatment of wounded animals, even these figures do not tell the whole story as the fiscal year ending June 30, 1941, was a year of peace and of relatively small army maneuvers. The use of animals in the field increases very largely the number and proportion of injuries due to violent causes. It might not increase the proportion of such ailments in the field in time of war but would largely increase the rate. During the Louisiana maneuvers in 1941, admission to the sick and wounded register of the 30th Veterinary General Hospital totaled more than 1900 in 50 days, yet only three cases of infectious disease were received other than cases of stomatitis, which were admitted for other causes. Instead of 50% of admissions being due to traumatisms as is normal in garrison duty more than 80% of animal casualties on the Louisiana maneuvers were due to such causes. Thus the treatment of wounds assumed more relative importance during the 1941 maneuvers than is indicated by the Surgeon General's report for the preceding year.

There have been several epochs in the treatment of wounds. Not so long ago in the history of medicine, the hot iron was regarded as a valuable wound application. With the development of the science of bacteriology during the last quarter of the 19th century less irritant disinfectants achieved popularity. Milder and milder disinfectant solutions came to be used more and more frequently until during World War I, Alexis Carrel and others introduced the hypochlorite solutions which were scarcely irritant at all and were applied continuously for many hours. Soon after the close of hostilities in 1918 it began to be pointed out that frequent meddling with wounds delayed healing more than did the original infection, consequently a rigid technique of rest for the parts and non-interference with the process of wound healing acquired many zealous advocates.

Contaminated Wounds

Wm. M. Mitchell, M.B., M.R.C.V.S., in an excellent discussion of "War Wounds and Their Treatment" at a meeting of the Scottish Metropolitan Division, N.A.M.A.[1] summed up recent improvements in wound treatment as follows:

One of the great advances in human wound treatment which originated during the last war, was the realization that, if casualties could be got to an operating theatre while a wound was still merely a contaminated[2] one, it was often possible to convert a severe lacerated wound into a clean one free from infection which could be sutured up completely.

* From an address by Lieut. Col. D. M. Campbell, V.C., at the annual meeting of the Michigan Veterinary Medical Association June 22-24, 1942.

[1] *Vet. Rec.* 52:3, pp. 33-36.

[2] During the first 12 hours a wound is regarded as contaminated, after that period as infected.

Even when it was impossible to bring the surfaces of a wound together on account of loss of tissue, the same early excision of contaminated surfaces was done.

To this end casualty clearing stations, where operative surgery could be done, were established just outside the zone of actual battle, so that cases could be operated upon within a few hours after their occurrence, before infection had begun to spread. Under six hours the method gave the best results, beyond this period the results were proportionally poorer. After anesthesia, complete excision of exposed wound surfaces was carried out with as much care as would be bestowed on any major operation; the instruments used for the purpose being constantly discarded or resterilized. The ideal of complete eradication of all contaminated tissue cannot always be achieved, but it was recognized that the natural defenses of the body were often capable of overcoming a slight amount of infection without a sutured wound breaking down.

This explains how occasionally accidental wounds in animals sutured early without much regard for surgical cleanliness sometimes heal without suppuration, but such exceptions are generally a surprise. Under field conditions, most of us engaged in the last war realized that suturing of wounds of horses was a sheer waste of time, so did not do it. If, however, horses should again come to be used in the army in large numbers, and it is possible to organize a rapid evacuation within 12 hours to casualty clearing stations, these stations should be so equipped and staffed as to make it possible to apply modern surgical methods in the treatment of wounds.

Septic Infected Wounds

The ritual of daily dressing of septic wounds with antiseptic lotions is still the common method employed, largely because of the faith most people have in the power of antiseptics to destroy organisms in wounds.

In veterinary practice we still have some who believe in the efficiency of astringent wound lotions and the irritant antiseptics such as tincture of iodine, perchloride of mercury, etc., but most have followed the tendency which developed during the last war to use less irritant antiseptics such as hypochlorite solutions(eusol, Dakin's solution), bipp, one or other of the flavines, dettol, etc.

It is now beginning to be realized that the undoubted success of hypochlorites and bipp in the treatment of wounds lies not so much in their antiseptic powers as in their low toxicity, thus allowing the healing process to go on unhindered, and the diminished tendency to interfere with wounds once the method has been started.

A method of treatment which is now exciting great interest is known as the Winnett Orr method. Winnett Orr, an American army surgeon, was confronted at the end of the Great War with the problem of moving some of his cases of severe compound fractures to the United States before the fractures had healed. He simply packed the wounds with sterile vaseline gauze and buried the wound and the two adjoining joints in a plaster of Paris cast. It has taken another war, the recent Spanish War, to bring home the efficacy of the Winnett Orr method of treating wounds, though for a number of years the method has been well known in the treatment of chronic osteomyelitis.

Trueta, who was in charge of a hospital in Barcelona at the time of the air raids on that city, has recently published a small handbook[3] which will well repay study, as many of the details of wound treatment in human beings can be applied readily to wound treatment in animals. He applied the Winnett Orr treatment, with slight modifications, on a large scale, and the success of the method can be appreciated from the figures he gives of the results obtained in 1,073 cases of open fracture of the limbs: 976 gave good or satisfactory results, 91 were bad results, and only six died. These figures are all the more amazing when we study the description and illustrations of typical examples of the wounds treated, many of them with shattered joints as well as bones. Whereas formerly amputation was the chief hope of saving life by stemming the progress of infection, he shows that by the methods he adopted many patients are now able to expect a good functioning limb at the end of treatment. It should be understood that the methods of treatment Trueta adopted apply equally well to wounds with or without fractures of bones, though naturally those where bones were involved provided the more spectacular successes.

The method of immediate treatment of war fractures as carried out by Trueta is best given in his own words:

1. Adopt surgical treatment as soon after the occurrence of the fracture as possible. The type of anesthesia must depend on the situation of the wound and the condition of the patient; it may be, according to circumstances, general, regional or spinal.

2. Once the patient is anesthetized, thoroughly wash the entire extremity, and the wound with water, soap and a nail brush, until the whole is completely clean and the wound itself is bleeding; shave all hair. Paint the surrounding skin with a weak alcoholic

[3] "Treatment of war wounds and fractures; with special reference to the closed method as used in the War in Spain." J. Trueta, M.D., pp. 143.

solution of iodine, without touching the wound in any circumstances.

3. Excise the skin edges of the wound, remove all contused tissue and widen the wound as much as may be required. Excise carefully and unhesitatingly all nonviable muscular and cellular tissues, noting in particular the color of the injured muscles, their contractility on stimulation with forceps and their capacity to bleed.

Open up the neighboring cellular space affected by the contusion and, where necessary, incise the soft tissues, following up the cellular spaces in the depths of the wound, always keeping in mind the need for adequate drainage. Remove any hematomas present.

5. Remove the majority of bone fragments that are completely denuded of periosteum or displaced, and all foreign bodies found at the site of fracture. There is no need to be concerned much about any pieces of bullet that are difficult to locate; but it is most important to excise carefully all foreign organic matter (pieces of clothing, wood, etc.). The procedures described above—namely, the removal of all foreign matter, the excision of all the tissues immediately surrounding the wound, including devitalized soft parts in the vicinity, and the opening up of cellular spaces—are known technically as débridement.

6. . . .

7. Once the fracture is reduced, dress the wound firmly with sterile gauze and immediately immobilize with plaster, including the two adjoining joints if possible.

8. Give an injection of tetanus antitoxin.

In some few cases where wounds were relatively uncontused and were excised within six or seven hours, he inserted a few interrupted sutures to allow of drainage between them (into the gauze) before enclosing the limb in a plaster of Paris cast. On no account should sutures be inserted if there is the slightest tension, or where there is doubt about the vitality of the tissues. The immobilization of the part by the closed plaster of Paris cast not only supports fractured ends of bones, but protects the injured soft tissues, especially the muscles, and thus prevents the spread of infection and absorption of toxins from wounds; in other words, it provides absolute rest of the part.

The closed plaster cast was also employed in the definitely septic infected wounds where the initial treatment had to be confined to the removal of foreign bodies and the provision of good drainage by enlarging the wound. The only exceptions not favorable to the application of plaster casts were cases where an acute cellulitis was already established or where there was a definite anerobic infection (gas gangrene).

These closed plaster casts were left on for long periods; premature removal, or even the making of a window, served to exacerbate local infections. Winnett Orr advises leaving the first cast on for as long as a month and the second for one or two months, but in Spain Trueta found the smell so intolerable to the patient that the first cast had to be removed after 10 to 15 days, though the second could be kept on from 20 to 30 days.

The only radical change Trueta made in Winnett Orr's method was that he employed sterile gauze instead of vaseline gauze, contending that the plain sterile gauze had a beneficial suction effect in the early stages.

The important lessons we learn from the Winnett Orr method of treating wounds are:

1. Antiseptics are not necessary to promote eradication of infection from wounds.

2. Infected wounds do best when allowed to "stew in their own juice."

3. The drainage of infected wounds to the surface must not be neglected.

4. The more completely a wound can be immobilized, the less risk there is of infection and toxins spreading by the blood and lymph streams.

Superficial Wounds

Fortunately there are many superficial wounds of everyday occurrence which do not require such drastic treatment as the Winnett Orr method envisages, yet if neglected or improperly treated they may be followed by serious incapacitating complications.

Superficial wounds, if seen early, can be dealt with by washing thoroughly with soap and water, using a sterile nail brush to get rid of contamination, and any shreds of devitalized tissue should be removed with scissors. Sutures can often be inserted and the wound protected by a sterile pad of gauze and a bandage.

In the clinical department of the Royal (Dick) Veterinary College surprisingly good results from this soap and water method of treating superficial accidental wounds have been obtained in dogs and cats when it has been possible to treat them within a few hours of an accident.

If a delay of more than 12 hours has occurred, beyond cleaning up the area around the wound, do not handle the wound roughly but merely apply a moist wet gauze dressing, which should be kept firmly in contact with the area by means of a covering of cotton wool and a bandage. This dressing promotes, by its suction effect, separation of the limited amount of necrotic and infected tissue, while the gentle pressure prevents excessive edema around the damaged area.

The moist wet dressing should be what its name implies—moist, not sopping wet—or its effect is harmful by promoting sodden granulation tissue. The material of choice as a wet dressing is gauze, four or five thicknesses at

least, wring out as dry as possible from 1-1,000 acriflavine or, occassionally when an area is edematous, out of a hypertonic saline solution, such as saturated magnesium sulphate or sodium chloride.

■ The treatment of wounds in animals has all along paralleled the trend in human

Sometimes a wire fence was contacted during night maneuvers

medicine but in veterinary medicine the pendulum has not swung so far in either direction and the methods, on the whole, have been better, with one exception. When strong antiseptic applications were the vogue, veterinarians used even stronger and more irritant applications than did physicians. This disadvantage, however, was likely more than offset in civil veterinary practice by less molestation of the wound, probably for economic reasons. Sometimes veterinary medicine has led the procession and human medicine trailed. About 30 years ago Merillat[4] and others began to advocate what was termed "uncarpeting" wounds—carefully trimming away the entire surface of contaminated wounds including all shreds and badly injured tissue. The results were good and the procedure was becoming established rapidly in equine practice when the slump came in that type of practice. "Uncarpeting" did not attain general adoption in the treatment of wounds of animals other than the horse. It was not till near the end of World War I that the medical profession adopted the method generally, renaming it débridement. Physicians refined the process, carried it further, obtained better results and adopted it more generally than veterinarians had done earlier.

■ Of the wounds occurring among the public animals on the army maneuvers in Louisiana during the summer of 1941 and evacuated to the 30th Veterinary General Hospital, injuries to the sole of the foot and of the withers and back were in the majority. Injuries due to kicks and from breaking through the floor of culverts and small bridges were fairly numerous and only less common were rope burns and jagged wounds from stakes, broken limbs on fallen trees, brush and down timber. Wire cuts, injuries from falling and many miscellaneous traumatisms occurred in small numbers.

Few of the wounded animals were admitted for treatment at the hospital until more than 12 hours had elapsed after the injury, so they belonged to the infected rather than the contaminated type and débridement was not regarded as indicated. Uniform treatment of all wounds was not practiced but a certain general routine was observed. The area about the wound was cleaned and shaved if haired. Foreign material was removed from the wound and, except for puncture wounds, the surface was washed thoroughly with soap and water. Shreds and other obviously devitalized tissue was trimmed away as were also ragged edges of skin or other tissues. After the open wounds were thoroughly cleaned and dried they were dusted with sulfanilamide and, if deep, protected for a couple of days by a gauze dressing moistened with a

[4] Merillat, L. A., 1915. Wound Treatment. *Vet. Med.*, Vol. X, 10:6, pp. 405-410.

saturated solution of magnesium sulphate. Further treatment did not include bandaging or protective packs, except in cases of rope burn.

Small deep wounds of soft tissue were explored carefully for foreign bodies and cleaned as well as possible with dry gauze. No liquids were injected into them, either to clean them or in the subsequent treatment. Where the drainage could be improved this was attained by enlarging the opening or providing an additional opening at the most dependent point.

In several of the puncture wounds resulting from kicks, joint capsules were opened. These open-joint cases included the elbow, knee and fetlock in the front limb; the stifle and hock in the leg. In such cases no attempt was made to explore the interior of the capsular ligament, only the surface wound was treated. When healed there was no impairment of function.

■ After the healing process in a wound was well started only mild desiccant powders were used on body wounds, chiefly as a protection against flies, and the same powder to which 5 to 20% of powdered alum was added was dusted onto wounds of the legs. Any removal of discharges that became necessary was accomplished by sponging with dry or only slightly moist absorbent cotton. Healthy parts onto which wounds drained were washed with soap and water as frequently as was necessary to keep them clean and render them unattractive to flies. There was little discharge except from deep wounds in the axilla and groin and those complicated by open joints.

In addition to the topical treatment of the wound all animals with grossly infected severe injuries and all with open joints were given sulfanilamide internally, one grain per pound of body weight divided into three doses and administered at eight-hour intervals.

It was not easy to evaluate the internal administration of sulfanilamide in most of these grossly infected wounds yet the promptness with which the profuse discharge of pus ceased in cases receiving it seemed to amply justify its use. But in the case of open joints there seems no question but that its use was beneficial. These cases usually came to the hospital with a profuse discharge of pus and synovia mixed, sometimes a great deal of pus and only a little clear synovia. The behavior of these open-joint cases was fairly uniform. In 48 hours after the internal administration of sulfanilamide was commenced the proportion of pus in the discharge was noticeably lessened; the swelling subsided; the animal suffered less pain and began to rest its foot on the ground. Within five or six days the discharge became clear synovia or synovia lightly flaked with pus. When this stage was reached the discharge decreased steadily in amount and in a few more days ceased and healing of the external opening then proceeded normally.

■ Only four cases of open joint treated in this way failed to recover. One, an open hock, was treated for two weeks by older methods before sulfanilamide was used. The wound healed and the soreness disappeared from the injured member but the deposit of fibrous tissue about the hock was so great as to interfere with the function of the joint at the trot. On this account the animal was destroyed as being unserviceable as a cavalry mount. Another case, an open elbow, which was under treatment only four or five days when maneuvers ceased and the hospital closed, was unable to stand shipment and for that reason was destroyed. However this case had not improved in the usual manner and the prognosis was doubtful. Lesions found on necropsy were probably irremedial. The third was a case of an open fetlock joint, which resulted from stepping through a hole in a plank floored culvert. After the case was treated two or three days the injury to the limb, aside from the open joint, was deemed beyond repair and the animal was destroyed. A fourth case, one of open hock, although it in no way differed in appearance from others that recovered, showed little improvement after being treated for three weeks and was destroyed as hopeless. Unfortunately circumstances precluded a necropsy in this case. No case of open joint developed laminitis, or gave down in the

opposite leg as has commonly occurred heretofore in such cases.

The foregoing plan of wound treatment was uniformly followed, with such modifications as circumstances dictated. Therefore, no controls can be cited to indicate whether it possesses advantages over older methods of treatment. However, the veterinary officers assigned to the hospital were unanimous in the opinion that most of the grave wounds healed with unusual promptness. Further, all had earlier observed fresh wounds treated by spraying with water an hour a day for three days, dressed with antiseptics and later with strong astringent applications. There was general agreement that healing was far tardier in such cases than in similar wounds treated with sulfanilamide on maneuvers.

■ Although the wounds treated in the manner described healed in a gratifying manner the treatment was not regarded as incapable of improvement and an effort was made to obtain sulfathiazole and urea with a view to compounding a dressing powder composed of 50 parts sulfanilamide, 25 parts sulfathiazole and 25 parts urea; but the latter two drugs were not obtainable. Theoretically the sulfathiazole should improve the dressing. On the same basis the urea should be advantageous in the deep wounds of the axilla and groin where surgical removal of devitalized tissue could not be complete. Considerable effort also was made to obtain ascorbic acid to give animals suffering from extensive injuries of the back and withers. But this too was unobtainable during the maneuvers.

Some veterinarians prefer solutions of sulfanilamide or suspensions in oil to the powder on the ground that the powder interferes with granulation; others object to the powder because it cakes in the wound. The experience detailed in the foregoing did not support either of these views. Granulation in the wounds was regarded as normal, which is to say it did not require repression in body wounds but was inclined to be excessive in wounds of the limbs. An explanation possibly lies in the fact that the amount of the drug used was small except for the first dressing, and even that larger amount was dissolved completely by wound secretions. By applying sulfanilamide directly to the wound, it is possible to obtain a concentration of it in the wound secretions 100 times as high as that attainable in the blood stream by internal administration. The bacteriostatic action of wound exudates carrying this level of sulfanilamide is almost complete. After the first application the sulfanilamide was dusted on the wound only lightly and after the discharge from the wound ceased, it was not applied at all.

■ The utility of thoroughly washing wounds 12 to 48 hours old may be questioned. A thorough scrubbing with soap and water seemed justified by the condition of the open wounds which were almost always heavily soiled with hair, bits of wood, bark, grass, sometimes manure, and always dirt and sand. Further, it may be pointed out, that although this was a section and a season in which Habronema infestation of wounds was common, only three, of hundreds of wounds of army animals, developed Habronema infestations and these were very mild and easily overcome. Whether entitled to it or not the initial thorough cleansing was given much of the credit for preventing this troublesome complication of wounds in the subtropics.

■ Reporting on the use of sulfanilamide as a wound dressing in the military hospitals after the Pearl Harbor attack Col. John J. Moorehead declared: "The results were better than I had ever seen during 19 months in France when serving with the French, Belgian and American Formations."

In summarizing his report on the treatment of casualties following the Pearl Harbor attack Colonel Moorehead stated:

Most of the fatalities were those suffering from internal abdominal wounds and those depleted by shock and hemorrhage. There were no deaths from gas gangrene and the discharge of pus from the wounds was almost absent, so much so that it became a subject of universal comment. There were no cases of tetanus, local or general, and the state of well being of the wounded was exceptional after the first few days.

This experience essentially duplicates that, related earlier, of the 30th Veterinary

General Hospital in the treatment of surgical wounds of the back and withers of animals during the Louisiana maneuvers. Since Pearl Harbor had to be, it is a matter of gratification that the opportunity to employ sulfanilamide extensively in the treatment of wounds came first to the Army Veterinary Service and its use there set a pattern for its life-saving employment by the Medical Service in the treatment of Army and Navy personnel at Pearl Harbor. Colonel Moorehead's statement that the "discharge of pus from the wounds was almost absent, so much so, that it became a subject of universal comment . . . and the state of well being of the wounded was exceptional after the first few days" describes exactly the oft-repeated comment of the veterinary officers on the treatment of wounds in the 30th Veterinary General Hospital by the local and general use of sulfanilamide.

Colonel Moorehead attributes the favorable outcome of the cases treated in the military hospitals in Honolulu on December 7th to:

1. Early receipt of the wounded—within the "golden period" of six hours.
2. Preliminary shock treatment.
3. Adequate débridement.
4. Use of the sulfonamide drugs in the wound and *per os*.
5. Adequate after care.

If I were to offer an opinion as to the measures contributing most to the results attained in the treatment of wounds of army animals on maneuvers I would say:

1. Thorough cleansing, including removal of all foreign matter and obviously devitalized tissue.

2. Local application of sulfanilamide and in grave or extensive wounds internal administration of the drug also.

3. Letting the wounds alone after the first treatment.

The value of thorough washing and complete removal of devitalized tissue is strikingly emphasized by saying that leaving such tissue in a wound is the exact equivalent of applying pieces of rotting meat to the wound surface. If any portion of muscle is discolored or has lost its contractility, or if any soft tissue will not bleed normally when nicked with the scalpel it requires immediate removal.

By No. 3 is meant that water and all manner of antiseptics, greases and oils were banned. When a crust formed on a wound it was not disturbed. Sulfanilamide was used as has already been stated until oozing from the wound surface ceased. After that any further applications were solely for protection against flies, not that flies would infect the wound, but to lessen movement of the tissues and to save the animals from annoyance. Where the panniculus carnosus is involved the movement of the tissues occasioned by flies is a serious deterrent of wound healing; not only because of interference with granulation but even more because it increases the lymphatic circulation —the principal route by which infection in a wound is extended. We cannot immobilize the wounds of animals to the extent that can be accomplished in man but all productive efforts to limit movement in the parts pay big dividends. In this connection good care and feeding should be mentioned. Nothing else contributes so much to the general comfort and feeling of well-being as thorough grooming and a full belly. All animals were groomed till their coats shone, good hay kept constantly before them and water given as often as they would drink. As a result they were quiet and the healing of their wounds greatly facilitated and thus expedited.

Common tendency to excessive granulation in large wounds of the limbs in horses is so well recognized as to make it scarcely necessary to mention that in such wounds the precept of non-molestation could not be carried out in its entirety. Such wounds usually required astringent applications during the latter half of the healing process.

Notwithstanding the traditional disfavor with which suturing wounds in horses is regarded, the degree to which the discharge from extensive wounds was suppressed by this thorough cleansing and dressing with sulfanilamide was a constant temptation to suture them. However the extreme pressure of the work during maneuvers seemed to preclude, or at least offered an excuse for not attempting to develop a technique for closing great, gaping, infected wounds.

Experiences with a Veterinary Pack Train in Eritrea

The fact that veterinary officers of the American Army are to be in India, Africa and the Middle East and if not in all those places abroad are expected to be there soon, heightens the interest in this account of army veterinary service in Africa. It was written by Captain J. H. McGhee of the Royal Army Veterinary Corps and published in the *Journal of the Royal Army Veterinary Corps,* (Feb., 1942):

Two mule pack transport companies were ordered to move forward for work in connection with the attack on a very difficult position in the mountains, where the enemy was making a determined stand after having been pushed back from the plains of the Sudan and Eritrea. After arrival at the railhead a long march had to be undertaken to reach the forward area. This was done by forced marches, taking twelve days. The longest day's march was thirty-five miles and took fourteen hours. The route lay through sub-tropical bush country quite thickly populated with game: ariel, gazelle, sand-grouse, etc. A number of these were shot for the pot and were much appreciated as a supplement to the hard rations which were carried. It should be mentioned that on this march the companies carried all their own baggage, rations and forage. In addition, one company was transport for a pack battery. All the mules commenced the march under full loads.

The animals stood the march well; there were a few cases of exhaustion and one company was forced to halt for a day's rest. Casualties, however, were few and were confined chiefly to saddle-galls, some of which were severe. It should be mentioned that the personnel were Cypriots and the standard of horse (or mule) mastership and line-of-march discipline was not very good, although the Cypriots are past masters in the art of handling mules and can handle a mule which British personnel would be unable to approach. Sudanese ponies were provided for officers and N.C.O.s. These are small, ungainly creatures, but carry astonishing weights, have remarkable stamina and can go for long periods without water.

On arrival at the forward area the companies went into action immediately. The work consisted of taking loads up precipitous hills, some of which were 6,000 feet above sea level, the climb to the positions being anything up to about 2,000 feet. Narrow, winding tracks had been prepared by engineer troops if none already existed. Mules did two or three journeys a day, each journey taking from two to three hours up the hills and rather less down. In some cases the tracks came under enemy shell fire and often the journeys were made during the night. The mule lines of one company were shelled out of several positions until a fairly safe place was found for them. This was in a valley, and the noise of explosions reverberating round the hills was at times deafening, especially when our own medium battery, which was in the valley, also opened fire. The other company were on a railway line several miles away. Their position also came in for a fair amount of shelling and bombing, artillery duels also taking place over them. An enemy pack battery which operated in this sector was a great nuisance.

The loads taken up the hills were very varied and it was found that practically any article could be carried on the pack saddle (Indian type). Amongst the loads were rations, water, ammunition (shells and S.A.), mortars and machine guns. On some occasions live sheep were carried for the Indians.

It should be mentioned that, although the temperature on the hills during the day was in the region of 120° F., at night it was bitterly cold. Many of our clinical thermometers were broken by the heat, and it was difficult to take temperatures during the day. If one was not quick in reading the thermometer each case recorded a high degree of fever! Temperatures were normally taken in the early morning or in the evening.

One Veterinary Officer was in charge of both companies, and each company had an R.A.V.C. Sergeant and two R.A.V.C. Privates.

It was not possible to evacuate animals to a base veterinary hospital, the nearest one being about 700 miles away. Therefore, a small hospital was established at the H.Q. camp of one of the companies; sick and injured animals from both companies being evacuated there. This hospital came to care for about a hundred such animals. Captured animals were also collected there, most of them requiring veterinary attention, being badly galled and in a shockingly debilitated condition. At the end of the action there were about two hundred of them, mostly mules but some ponies and two camels, the last-named being rather a problem to deal with until someone was found who knew their ways and habits.

The Veterinary Officer's routine was to inspect the sick in the hospital and perform such operations as were necessary before breakfast. Afterwards the advanced mule lines were visited, which, as already noted, were widely separated, and this took up the greater part of the day. Inspection of the sick at the advanced lines was made to decide which animals to rest, send to duty or evacuate. Evacuation was carried out by motor transport for animals which were unable to walk, otherwise they were marched back, the conducting party returning with animals discharged from hospital as replacements. It had to be borne in mind that it was absolutely necessary that every mule which could work should do so, owing to the vital necessity of getting supplies up to the men who were fighting in the hills. There was therefore a tendency to allow animals with minor injuries, such as saddle-galls, to go to work when they really should have been rested, and as a result some of them became major injuries.

A notable fact was the low number of deaths among the mules—only a few were killed, although they came in for a fair amount of shelling and bombing. A large number of gunshot wounds also occurred, some of them very serious.

In one case with an abdominal wound there was a protrusion of a small piece of the intestine: this was returned under not very aseptic conditions and the wound sutured; the animal made an uneventful recovery. Another mule had a shell burst under its belly and about thirty pieces of shrapnel had to be removed. The animal suffered from a certain amount of shock, but made a rapid recovery. The rapidity of healing of the wounds of the mules was remarkable, in contrast to those of the men, which healed so slowly and tended to develop into a nasty sloughing ulcer known as "desert sores."

A lot of trouble was caused by birds of very gaudy color which pecked the wounds. At first it was thought they would only peck away the necrotic tissue and thus assist us in our work, but it was quickly seen that they were not so obliging and it was very annoying to find that a small wound had suddenly become a large one as a result of the attention of these creatures. Various devices had to be employed to keep them off; Stockholm tar was found to be most effective. It was surprising how the mules would stand and allow these destructive birds to peck away at their wounds, but on the other hands would kick like fury when approached by the dressers, whose attentions were much more merciful.

The forage received was generally of poor quality and consisted chiefly of millet, Indian hay and tibben, with some bran (which was actually quite good) and occasionally dries. It is a noteworthy tribute to the mule that after twelve days of forced marching and a fortnight's hard work in action their condition was, on the whole, good. They did, of course, lose some condition, some more than others, but there was not a single case of debility.

Owing to the stony nature of the ground it was found necessary to shoe the animals all round. When owing to shortage of shoes it was not possible to do so, a number of animals became footsore and some had to be rested. It was feared that the units might be immobilized and urgent demands for shoes were sent, the shoes being received very quickly.

There was a good supply of veterinary stores, fresh supplies being received during the action. Also some veterinary stores were captured from the Italians and came in very useful. The impression was gained that the enemy used too many medicines to be good veterinarians.

At the conclusion of the campaign one company remained in Eritrea to perform salvage work. This work consisted of taking the stores down the hills which, ironically enough, they had previously worked so hard to take up. The other company returned to Egypt via the Nile Valley route, a long march being necessary to reach the railhead. On this march the transport problem was much relieved by the acquisition of some captured motor trucks so that the mules had only light loads to carry. Two water trucks were attached for the supply of water to men and mules. Native water-holes were few and far between and could not be relied upon. Mules were watered twice daily. The heat during the day was most intense, any metal—for instance, knives and forks or the steering wheel of a car—being almost too hot to touch. It was therefore customary to march at night, and on this occasion a brilliant moon rendered it almost as light as day. The night life in these parts was considerable, for frequently natives were met trudging through the night, usually at a sort of half-trot. Here and there little bands of them lay round a fire, one of their number seemed to be a picquet to keep the fire going in order to keep away the various wild animals which roamed the countryside at night. There were plenty of hyena about, and it was thought that there might be lions, too. Loud growlings and roarings used to be heard frequently and often padmarks of obviously large carnivora were seen. Of course, it is the habit of all natives to regard any animal of any size which moves at night as a lion, especially if that animal also "growls." On one occasion there was a great deal of confusion and excitement in the camp when shouts of "lion, lion," went

up and a number of shots were fired .On investigation it was found that a mule had broken loose and wandered through the lines.

During this march the veterinary personnel had a lot of work to do, as there were a number of cases to be dressed, and it was their unfortunate lot to have to work at the end of a march when most of the troops were able to rest.

Stockholm tar was found to be the most suitable dressing for wounds, and if applied on a thin layer of cotton-wool it remained in position. It was easily obtained from any bazaar in that country, where it was known as *"gutran."*

One incident of veterinary importance occurred on this march, in the shape of an outbreak of what was thought to be African horse sickness. Other units had experienced it and it was called by the natives, who were questioned about it, *"nigma";* but it seems that any serious disease of animals in these parts is known as *nigma.* At all events, it was known to be a serious disease. One unit had seventeen dead and fifty sick in three days. The appearance of such a plague caused some misgivings, because it was feared that the unit might be immobilized for some weeks in this waterless, subtropical bush. The C.O. was informed of the occurrence of this disease, one animal having been reported sick with it at 7 p.m. and dead in two hours. He was advised to move to the nearest village, about fifteen miles away, where there was water, and halt the unit to await developments. This was done, but in the meantime another death occurred. A signal was sent to G.H.Q. informing them of this, and also to the A.D.V.S. It happened, however, that the A.D.V.S. was in the area and would be passing along the one and only road. A notice was put out on the road giving the name of the unit with an arrow pointing towards the camp, and saying "A.D.V.S. Wanted." Two days later he arrived. By this time another death had occurred and several suspects and incontacts were isolated.

It did seem that the attack was not as severe as had been experienced by other units, and as it was possible that the unit was required in another theatre of war the A.D.V.S. gave authority for the unit to move on. Only one other death occurred, so it turned out to be a very mild outbreak, perhaps due to the fact that the unit was moving out of the zone of this disease. The nature of the disease was not definitely established. The unit had been inoculated with a vaccine containing several strains of the virus of African horse sickness. The typical edema of the lungs and frothing from the nose did not occur. The symptoms were swelling of the supra-orbital fossa and inter-maxillary space, blue discoloration of the gums and tongue, in one case the passage of blood-stained urine, a temperature of about 103° F., and the usual signs of fever, with death usually in a few hours. It may have been a form of the disease peculiar to that country. The Sudan Veterinary Service had had no experience with it, and if the Italians had there was no record of their having investigated it.

The march was completed without any further incidents, and it was good to have a few days' rest at the railhead awaiting the train, which went as far as Wadi Halfa. From there the journey was continued by river steamer (the animals going in barges lashed to the side of the steamer). Three days on the steamer was indeed the pleasantest part of the journey. The journey into Lower Egypt was completed by train. On arrival there we were eager for the latest news. No one had seen a paper for many weeks; occasionally a news bulletin outside some Town Major's office was seen or someone was met who had heard a news broadcast a day or two before; news two days old was regarded as very recent.

Thus ended a journey of tremendous interest full of never-to-be-forgotten experiences and in which some part had been played in helping to defeat the enemy. But how nice to be able to enjoy some of the comforts of life in Egypt!

One final word: praise for the mule. As is known, most animals lose condition on a long rail journey, but the mules had so improved that when the D.D.V.S., M.E., inspected the unit on the day following their arrival in Egypt, he gave a very good report on the condition of the animals and even remarked upon the fatness of some of them.

Effects upon Domestic Animals of Air Raids in England

By ERIC HARDY, F.Z.S.
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AMERICAN animal experts are now probably in the same position in which we found ourselves when the first air raid sirens sounded so long ago as the almost forgotten autumn of 1939. We were prepared. We had booklets issued by the Government and the Royal Society for the Prevention of Cruelty to Animals based upon information gathered from the British and French Army Veterinary services in the last war, and based upon sound ideas for treating animals after gas, bomb and other injuries. Three years later we are even better prepared because in the experience of blitz after blitz we have unlearned a lot of the stuff we learned in those fateful September days: problems about animal casualties of which we never dreamed have arisen and been dealt with successfully. The whole of the Air Raid Precautions for Animals has been revised and re-organized. A fault that still exists is we now have no one central National A.R.P. for Animals Committee including representatives of the veterinary associations, the animal welfare societies, dogs' homes, horse shelters, animal clinics and the Government, because they could not agree upon financial matters. The numerous independent organizations that split to work on their own, will, however, do the job effectively, and their experience and methods should be of considerable value to American veterinarians.

The most important discovery made has been that far fewer animal casualties occur in a raid than was originally expected, and although there are usually sufficient qualified veterinarians to meet the demand after a big blitz however, in case of need, this number is readily augmented by "Animal Wardens" which have been trained in animal first-aid and who can be stationed at first aid posts in each district. It is also advisable to have "Animal Guards" in the various streets to bring animal casualties to these wardens so that only the more serious cases go to the veterinarians. There is also a system of mobile veterinary clinics to rush extra help from various centers into the concentrated area of the blitz. The greatest problem is that of the stray, homeless dogs and other animals after the blitz. They cannot just be rounded up and housed at dogs' homes and other centers owing to the risk of starting epizootics. A number of street detention posts are therefore used.

The animal casualty statistics in Britain up to the summer of 1942 were, so far as they were officially recorded:

	Total Casualties	Killed Outright	Received Treatment	Saved	Destroyed
Horses:	780	216	282	45	237
Cattle:	2,132	524	520	724	364
Sheep:	1,377	757	57	297	266
Pigs:	750	216	25	393	116
Total:	5,032	1713	884	1,459	983

London reported 102,600; Birmingham 6,100; Manchester 4,600; Coventry 2,400; Liverpool 2,400; Plymouth 2,100, and Swansea 1,100 bombed-out stray animals. These figures, issued by the present NARPAC (National A.R.P. for Animals Committee), which doesn't include even the larger part of all the animal welfare and veterinary bodies, are only the cases reported. Since it is not compulsory to report animal casualties in raids, the true figures are no doubt considerably higher than these.

In the early days of the raids on London, vast numbers of dogs and cats were rendered homeless in the Silvertown area, which in a few days became dangerous to humans because of starving packs of dogs that took possession of evacuated houses. Excepting for cats which are left behind to keep down the rats and mice in the blitzed buildings, the homeless, wandering animals are now rounded up after each raid and sent to detention posts until their owners are traced, otherwise they are destroyed.

Animals were found to suffer considerably from blast, just as do human beings. Many animals have died from shock. I had charge

of an animal first-aid post in one of our most often raided cities. When houses came down, the domestic cat or dog had generally gone down to the basement or cellar because of its fear of the noise and often was not discovered until three to five days later. They showed all the trembling and shivering symptoms of humans suffering from bomb shock and required the same warmth and stimulation. When the war began we were given bromide sedative tablets to give to dogs and other animals when a raid began so that the crashing of bombs and banging of anti-aircraft guns would not alarm them. I never used any of mine. When people came to me and said that their dogs "went off their heads" whenever the raids began, I advised these people to take sedative tablets. Gradually they understood. The dogs responded exactly like their owners. If, as soon as the sirens wailed out their warning, the family became excited and went rushing about the place and then bolting into the

Raids in the early days of the war left great numbers of dogs homeless. These starving packs took possession of evacuated houses and became a menace to the community.

air raid shelter, there to sit with their nerves keyed up, ready to jump at every explosion, the dogs ran wildly about the place barking and jumping and it was almost impossible to get them into the shelters. If the family behaved quietly the dogs paid little attention to the blitz. My own collie always barks when the sirens start or even when an enemy plane comes droning overhead before the sirens, because he knows it is a danger signal. But in the air raid shelter he merely trots to his corner and goes to sleep without showing any concern for the commotion outside—not even

Stray cats secrete themselves in blitzed buildings in ungetatable places

on the occasion when a parachute mine blitzed our house. When a heavy high explosive crumped into the ground near enough to send some big earth tremors, he started up from his sleep, as if wakened, but soon lay down again.

With farm stock, we found that our original ideas of collecting horses and cattle into stables whose walls were reinforced with sandbags and earth boxes and windows made gas-proof with damp sacks and blankets, was not practicable. It was much safer to leave the animals grazing in the field. They took no notice of the air raids unless they experienced an "incident." Because they lacked our knowledge of the painful consequences of the sirens, bombs and gunfire they knew no fear. Often bombs dropped in open fields without killing any of the stock for the loose earth absorbs a lot more of the blast than does the hard surface of a city street. But once an animal was hit by a shrapnel or bomb splinter, it always afterward became alarmed at the sirens or gunfire, for it associated its pain with the raids. When a bomb fell on a stable in which animals were collected it killed a large number that would have been saved if they had been left in the fields.

As can well be imagined, veterinarians have no easy task working with a masked hurricane lamp in a stable or in an open field during blackout conditions in the mid-

dle of a winter night raid, unable to shine a torch or show a light, with two or three hours to go before the raid stops. But the work has been done. Originally it was planned that most of the farm stock killed by bombs could be used for human food, but it was found by experience that very little can be salvaged for the meat market. In rural districts animals and human populations are widely scattered and often it is some time after a bomb has fallen that animal casualties are discovered, and often it is not known when the animal was killed. Usually it is not until next day, or even later, that a butcher can be brought out to dress the carcass. By that time the meat is unfit for human consumption. The big raids take place at night after the animals have had their main meal and their intestines are full of half-digested food which rapidly decomposes and taints the flesh. At the packing houses, animals are starved the day before slaughter to avoid this contamination. The remedy for this is to train a man on each farm in the elementary butchery or slaughter-house work to make the animal clean after it has been killed.

In the streets, all cart horses are required by law to wear a second emergency webbing halter and short cord lead. Originally when sirens sounded, the carters braked their carts and tied the horse by this halter to the back wheel, so that it could not bolt from fear during the raid. This is not now generally practiced, as men find they can keep their horses under control and get them safely off the streets to stable or field with less effort and comparatively more safety. Stray cats are a problem in blitzed buildings because they secrete themselves in difficult ungetatable corners, and are most dangerous to the public. A cat-grasper has been devised to bring them

Carters now keep their horses under control and get them off the street to a field or stable, rather than brake their carts and tie the animal to the back wheel until "all clear" is sounded

out of such places. It consists of a long hollow cane, or bamboo pole, with a cord passing through it and a running noose at the far end. The noose is worked over the cat's head with the aid of the pole, the string is then pulled to draw the cat up to the end of the pole. If possible it is pulled out and treated if necessary but if this cannot be done the cat is held in position and under control, unable to move, while it is humanely killed.

Practical experience has shown that, while detention posts for stray animals have many uses, the answer to the problem of care of stray animals immediately after raids, is to be found in the organization of a chain of Refuge Homes in the residences of house-

Early in the war it was expected that farm-stock killed in air raids could be made available for human food but up to the present this has proved impracticable

holders prepared to accept one animal, or at the most two, for periods up to three days. Such people with their addresses are listed beforehand at the local NARPAC post or animal clinic. Eight thousand animals have thus been rescued, eight being treated, 3,392 returned to their owners and 4,600 destroyed since their owners were unknown. The number of actual casualties after an air raid has seldom been more than local veterinarians could handle without assistance, but to save them trouble with minor cases of small animals, first-aid posts were established at the homes of animal guards. These first-aid posts are provided with a NARPAC first-aid box for small animals. These standard small animal boxes contain: A 10-oz. bottle of antiseptic, an 8-oz. bottle of disinfectant for cleansing wounds, a 6-oz. bottle of boracic acid eye lotion, a 3-oz. tin of zinc oxide ointment, a 4-oz. jar of tannic acid jelly (2 percent) for burns, a bottle of 25 (5-gr.) sedative tablets for dogs with hysteria or panic (more useful when given to dog owners who show these symptoms!), a 5-yard spool each of one-inch and two-inch adhesive tape; a dozen safety pins, four wooden splints (12 by 1½ inches, 9 by 1 inches, 6 by ¾ inch and 4 by 1 inch), a dozen each of bandages 6-yards long by 4 inches wide and 6-yards by 2 inches, a 4-oz. roll of cotton wool, one dozen 6-inch gauze tissue squares for placing over wounds before dressing, and a hank of 1 inch linen tape. If there is anything else I would recommend for similar "first-aid for animal" boxes in America, it would be a humane killer and its cartridges, for use in case one has to despatch a horse or beast suffering from ultimately fatal injuries. It is important, however. that animal first-aid posts must act in co-operation with air raid wardens, fire-watchers, police and others on duty during air raids: they cannot rely upon animal guards who may be unable to find all or even any of the animal casualties. The post must be officially recognized and known at the local air raid warden's sector post.

Nearly 1,000 veterinarians are in charge of 6,000 first-aid for animals mobile units—speed is just as essential in dealing with injuries to valuable farm stock and horses, as with humans. Apart from salvage, when the Ministry of Food pays the market price for farm animal carcasses still fit for human consumption, Britain pays no actual compensation to owners of animals that are killed in air-raids, until after the war. Domestic pets are not allowed in public air-raid shelters, for obvious reasons, but some owners, chiefly women, have caused scenes over this point. Horses stabled in towns often have to be rescued from burning stables and the risk of stampeding is avoided by throwing sacks, slit down one side, over the animals' heads before they are lead out of the burning building.

Summing up the three years of war upon which we can base our plans for preparation for the second front and the future raids, we can say that the real effect of heavy raids upon towns is not to produce a staggering list of animal casualties and deaths, but an embarrassing number of stray animals with homes destroyed, which are wandering about the place without collars or other means of identification, and the owners of many of which may not be traced because they have been killed. At the famous London Zoo in Regents Park, and its country establishment at Whipsnade Park, Bedfordshire, there have been only eleven "incidents" during air-raids (eight at the London Zoo and three at the Whipsnade Zoo). During these there were 55 high explosives, two oil bombs and 200 incendiary bombs which hit the Zoo, and although considerable material damage was done to buildings, very few animals and no attendants were seriously injured. In many towns, however, the veterinarians have seen their livelihood taken away because the place has been so blitzed that there are far fewer animal owners living than is necessary to provide them with employment. At the beginning of the war many thousands of valuable dogs and other animals were killed by their owners who were anxious to save their pets the agony of raid damage, but there was never any need for this and we hear nothing now of the 1939 advice to evacuate all dogs and pets from the towns to the country.

Chemical Warfare

Its Effect on Army Animals and Food

AT the present writing but slight use has been made of poisonous and suffocating gases in the current conflict, but there appears to be good ground for the belief that before this war is over such agents will be used on a far greater scale than ever before. All major combatants have prosecuted research into chemical warfare continuously since World War I and it is known that at least two of the Axis governments have accumulated enormous stocks of chemical warfare agents.

Chemical agents may be used (1) directly against enemy personnel, (2) to contaminate his food supply and, (3) against his animal transport to hamper his mobility. When used effectively against his own forces the employment of chemical agents for the second and third of these objectives concerns the veterinary officer in his professional capacity as food inspector and conservator of animal efficiency. The first concerns him as it does other officers personally, and also as commander of detachments and organizations. However his duties in the decontamination of foods and in the treatment of injured animals require that he possess a knowledge of the methods for the protection of personnel from the effects of chemical warfare equivalent to that of the medical officer. Hence the veterinary officer's responsibilities, when chemical agents are employed in warfare, are varied and important; and a comprehensive knowledge of the subject is required of him.

It is generally assumed that no new gases, that is, gases which were not used in the previous war, will be largely employed in this one. It is not a safe assumption for if the use of hitherto unutilized poisons were planned by any combatant, of course it would be kept a carefully guarded military secret. So far as the well-known gases are concerned their effect in rendering food, water, and forage supplies unpalatable or harmful is only incidental to their use against personnel and animals. The effectiveness of high explosive and incendiary bombs in the destruction of stored food and forage or of biologic agents and poisons (not ordinarily classed as chemical warfare agents) against water supplies, is such as to render unlikely chemical warfare directed primarily against either food or water supplies.

However if poisonous and suffocating gases, including readily diffusible liquids and finely divided solids, should be used in the manner now commonly discussed—that is by spraying them from low-flying airplanes in quantities never before envisioned —it is inevitable that food and forage supplies in the possession of troop organizations will be contaminated. Supplies stored in buildings or packaged in wooden or metal containers will seldom be endangered. Food or forage will be damaged but rarely, if at all, by poisonous vapors except it is exposed for a considerable period to arsenical fumes. It will require decontamination or to be destroyed only if liquid poisons have been splashed upon it.

From experience with chemical warfare in World War I it is apparent that only mustard gas and agents containing arsenic are likely to be of importance as food or forage contaminants. Considering the forage first; dry hay and grain are peculiarly resistant to the effect of fumes from these agents and the slight contamination possible can be removed by washing, or if the water supply is limited, by even a small amount of sodium carbonate solution. Or they may be rendered safe to use by spreading in thin layers exposed to sunshine and wind.

When contaminated by droplets of liquid mustard, Lewisite, or hydrocyanic acid it is best to discard the forage or, if it is much needed, to destroy the outer layers of the pile and decontaminate the remainder, if necessary, by washing. This will not remove all the arsenic but horses are peculiarly tolerant to arsenic.

Where tarpaulins or other canvas is available for covering stores of grain and hay, it affords adequate protection and its use should not be neglected in danger zones.

Many food stuffs, particularly those containing a large percentage of fats, are easily contaminated by chemical warfare agents. Decontamination of such foods is difficult and every practical precaution should be taken to safeguard them. Foods in cans, or other metal containers, are safe from contamination as are also those in tight wooden boxes especially if wrapped, as is the custom, in waxed paper. Buildings, also coverings of treated or waterproofed canvas, offer good but not complete protection. If contaminated with the arsenical agents foods should be destroyed. Those contaminated by droplets of mustard gas can be salvaged if trimmed and aerated promptly. Washing with water or a solution of sodium carbonate will remove much of the poison. Neutralizing agents may render the food unpalatable. Unless large quantities of food are involved, or it is irreplaceable, seriously contaminated food should be discarded; particularly meat, vegetables and fruits.

The protection of army horses from harm during gas attacks devolves primarily upon the riders and drivers and therefore is a responsibility of the commanding officer. The effect of any poisonous gas is dependent upon two conditions — degree of concentration and time of exposure. The attacked can rarely influence the former and the short time during which exposure to high concentrations can be endured make it impossible for the veterinary service to afford protection to more than a few animals. In fact, in attacks that come as a complete surprise, it is doubtful that the animal's attendant can afford it protection against lung irritants. Although a serviceable gas mask for horses has been developed, the soldier must first adjust his own mask and then that of his horse. Even this short delay may be too long.

Although the veterinary officer's advice as to means of affording protection to the army animals against chemical warfare agents must be available to his commanding officer, it is for the treatment of the animals after they are injured that he is directly responsible.

The treatment of animal casualties resulting from chemical warfare depends, of course, upon the extent and nature of the injury; and, these in turn depend upon the agent used and, as already mentioned, upon the concentration to which the animal has been exposed, the duration of the exposure and also the time that has elapsed between exposure and the beginning of treatment. Horses and mules tolerate relatively well certain agents which quickly incapacitate soldiers. Some agents have much the same effect on both soldiers and their mounts. Among the former may be mentioned the lachrymators (tear gas), sternutators (sneeze gas), and gases that cause vomiting. Lung irritants affect animals much as they do men and vesicants act even more severely upon the horse than upon his rider. General therapeusis for animals injured by lung irritants and vesicants are as follows:

Lung Irritants

1. *Phosgene* (carbonyl chloride, palite), CWS symbol CG, is a colorless gas with an odor of ensilage. It is delivered by artillery or mortar shells, projectors and cylinders and it causes coughing, lachrymation, dyspnea and after several hours edema of the lungs.

2. *Chloropicrin* (trichlornitromethane, vomiting gas), CWS symbol PS, is a colorless, volatile liquid with the odor of fly paper or licorice. It may be delivered in the same manner as phosgene and also by spraying from airplanes. The symptoms produced by it are similar to those caused by phosgene but are more severe. In addition skin irritation may be caused by drops or splashes.

3. *Chlorine,* CWS symbol CL, is a greenish yellow gas with a pungent well-known odor. It is delivered from cylinders and projectors and also causes symptoms similar to phosgene but the cough is more distressing. The after effects are more prompt but less toxic than from phosgene.

4. *Mustard,* while this agent when vaporized or inhaled as a mist is a lung irritant its most important effect on animals is as

a skin irritant and the discussion of it is included among vesicants.

Treatment: Since the lung irritants are also eye irritants, early treatment of the eyes is essential. This consists in washing or irrigating the conjunctival sac with solutions of sodium bicarbonate or of boric acid to remove any remaining irritant. They should not be covered. Cocaine is contraindicated; other local anesthetics should be used as required. If conjunctivitis supervenes symptomatic treatment as for conjunctivitis from other causes is indicated.

The immediate effect of lung irritants on the respiratory apparatus is to induce coughing. Except in case of heavy concentrations this symptom may soon disappear and the veterinarian may have to rely upon the history to determine that the animal has been gassed. Exposed to a light concentration, particularly of phosgene, the animal may appear entirely normal for several hours and then sometimes as much as 12 hours after the exposure suddenly develop a fatal edema of the lungs, or die from circulatory collapse preceded by dilation of the right heart. Or, surviving the secondary effects of the gas, the animal may develop pneumonia of a prolonged, mild to fatal type.

The first and most urgent requirement of any animal that has been injured by a lung irritant gas is rest. If this is not provided the case is prone to proceed to a fatal termination regardless of how skillful the other treatment may be. It is important of course to get the animal out of the gassed area as soon as possible but even the urgency of this life-saving measure should not cause the animal to be hurried. It should be led slowly to a non-contaminated area and there given complete rest for 24 hours. Draft animals should be unhitched and ridden animals unsaddled before they are led quietly from the contaminated surroundings.

Phosgene damages the lower part of the respiratory system—the endothelial lining of the finer bronchioles and of the alveoli. It also injures the capillaries surrounding the air cells, leading to edema, dyspnea and impaired circulation.

Copious bleeding, as soon as the edema of the lungs is in evidence, has attained considerable popularity for this type of gas poisoning. After drawing 4000 to 5000cc of blood, that which remains in the blood vessels is thinned through abstraction of fluid from the tissues. That this facilitates the passage of blood through the injured capillaries is the theory upon which venesection is based. A number of other postulates have been offered to explain the improvement that sometimes follows bleeding but none of them will withstand analysis in the light of known physiological principles. Other than bleeding, upon the value which there is not a unanimity of opinion, the treatment of edema of the lungs following exposure to lung irritants is supportive and symptomatic. Continued rest is of course a prime requisite.

The effect of chloropicrin differs from phosgene only in degree (chloropicrin being less toxic but more persistent than phosgene), and the treatment is the same.

The effect of chlorine gas differs from phosgene and chloropicrin in that it has an immediate and extremely irritating effect upon the respiratory mucous membrane. It occasions a distressing and continued cough and much pain in the chest accompanied by a sense of suffocation. High concentration, because of its great

chemical activity, affects only the upper respiratory tract, constriction of the bronchioles prevents the gas from reaching the lungs. Death may occur within a short period from edema of the larynx and other respiratory passages. If the animal survives the primary effect, necrosis of the mucous membrane followed by bronchopneumonia commonly occurs. The treatment of poisoning by chlorine gas differs little from the treatment of other lung irritants. As with

AN IMPROVISED SMOKE SCREEN

By the simple expedient of firing the tall dry grass on a river levee soldiers on maneuvers contrived a smoke screen that permitted their withdrawal when attacked by superior "enemy" forces

the others rest is indispensable to a successful outcome.

All the lung irritants prepare the field for secondary bacterial invaders. Pneumonia is a common sequel to gassing.

The gas mask now available for horses affords complete protection against the lung gases. Unlike former gas masks used on horses this interferes scarcely at all with respiration and can be worn by the animal many hours without discomfort, even while working, i. e. ridden at the usual pace. The aim is that it be put onto the animal before it enters a dangerous area and worn whenever there is danger of encountering gas.

Irritant Smokes

Screening smokes consist of fine particles of solids suspended in the air. Their effect is harassing rather than incapacitating although a number of them are conjunctival, nasal and lung irritants. However, if the exposure is short, a few minutes in the open air suffices for recovery. The gas mask affords complete protection against irritant smokes.

Vesicants

1. *Mustard* (bisbetachlorethysulfide, yperite senfgas), CWS symbol HS, is a dark brown to straw yellow, oily liquid with an odor like that of garlic, or horse radish. It is adapted to delivery by artillery shells and bombs and to spraying from low-flying airplanes or from trucks. The vapor causes delayed irritation of the conjunctiva. Inhaled it causes irritation of the respiratory tract. Neither the effect of vapor on the eyes nor on the lungs is ordinarily serious in horses. However minute droplets striking the eye cause intense inflammation, ulceration and often blindness. Inhaled in the form of a mist, mustard leads to destruction of the respiratory mucous membrane and early death from suffocation. Or if the animal survives the primary injury, secondary infection develops, the prognosis of which is unfavorable. When the liquid reaches the skin in droplets or larger amounts it causes deep destruction of the tissues. When ingested on forage or when grazing, it causes severe stomatitis, pharyngitis and enteritis.

2. Lewisite (betachlorvinyldichlorarsine), CWS symbol M-1, is a colorless to brownish liquid with the odor of geraniums. It may be dispersed in the same manner as mustard and the symptoms are similar to those caused by mustard. In addition there is a possibility of systemic arsenic poisoning where a high concentration of the vapor is inhaled or a large area of the surface of the body is contaminated by Lewisite in liquid form.

Treatment.—Specific treatment for the vesicants consists of neutralizing or removing the poison. This constitutes adequate treatment where it can be accomplished early enough but their action on the skin is so rapid that to be completely successful it must be accomplished within 10 minutes and therefore needs to be carried out by

the animal attendant. Neutralization of the poison up to two hours after it has been splashed on the skin is of some value and should not be neglected as the first step in treatment.

Lewisite is easily neutralized by alkaline

MUSTARD DERMATITIS IN A MULE

Burns such as this are usually from contaminated saddle blankets or pack saddles or from covering the animals after droplets of mustard have fallen on the coat. During World War I veterinary evacuation stations received many such cases carded as "mange." The true nature of the condition might not be revealed for a week. Mustard burns on the back of animals were usually the result of dripping of the irritant from overhead branches of trees. Frightful burns of the sheath resulted from traversing contaminated shrub land. The concentrated irritant in shell holes, wheel ruts, etc., inflicted fatal injury to pasterns and fetlocks.—*Vet. Mil. History*

solutions; a 5% solution of sodium carbonate is recommended. Mustard is difficult to neutralize. The reaction of chlorinated lime with mustard produces great heat and this agent is suitable only for decontaminating ground areas, bushes, paths, etc. Bleach paste (bleach 50 parts, water 50 parts) and bleach ointment, much used in the treatment of man, may injure the skin of the horse even more than the mustard if not promptly removed. Its use on horses is not advised, except under the direction of a veterinary officer. Carbon tetrachloride, kerosene and gasoline are useful to dilute and in part effect the removal of mustard from the animal's coat. It should be applied with sponges and sopped up. Rubbing distributes the irritant and increases the size of the slough. Contaminated areas should be washed thoroughly with soap and water after the solvent is used; or if a solvent is not available the areas should be wiped carefully and then washed. If bleach is used the paste is preferable to the ointment. It requires to be thoroughly rubbed into the coat at the site of contamination and washed off within five minutes.

Mustard has been termed "King of war gases." It is inexpensive, can be manufactured in any required amount, is easily dispersed and is very persistent, (it persists for weeks or even months under favorable circumstances) and acts energetically. A droplet the size of a pin head on the coat of a horse will destroy the underlying skin over an area larger than a half-dollar coin. This section of skin will slough and the wound may require months to heal. Contaminated saddles, blankets, harness, anything that comes in contact with the animal may injure it after days or weeks if not decontaminated.

Cavalry animals are particularly endangered by mustard. It is used by troops on areas they do not expect to occupy. Thus if a withdrawal is being carried out the area may be sprayed with mustard by airplanes or tank trucks as a deterrent and hazard to pursuing troops. It is conceivable that critical flank approaches to a line of march or to important installations such as bridges or rail junctions might under some conditions be protected by mustard.

Mustard in liquid form may be sprayed upon animals by airplanes or drip upon them from overhead trees, or may be brushed off tall vegetation. It may reach the extremities from grass or small pools. Contaminated forage or pastures may be a source of injury to the mouth and intestinal tract of a horse. The decontamination of forage has been mentioned. Pastures are safe after heavy rains or several days of warm sunshine.

The coat is roughened; i.e., the hair stands erect on contaminated areas an hour after contact with mustard. After 10 to 15 hours extensive edema occurs which subsides after one to three days and the injured area becomes harder than normal. In another 10 days the hardened plaque of skin begins to separate, at the circumference, from the normal skin. In the course of about three weeks the mummified skin detaches from the underlying tissue and is cast off. The wound that remains is indolent and prone to secondary infection.

Picket lines and other concentrations of animals constitute attractive installations for gassing. The usual requirements of camouflage, where they can be met, afford considerable protection. In addition the horse gas mask, as already mentioned, affords complete protection against inhalation of mustard or other war gases. An eye shield has been developed for protection against overhead spray. The ordinary horse cover affords adequate protection to the body if it be removed and decontaminated within 15 to 20 minutes after contact with mustard. A pervious cover is preferable to an impervious one since it can be worn with much less discomfort to the animal. Leggings of impervious material have been developed that protect the legs from the body to the hoof. Leggings were used in World War I but were not satisfactory. It is thought the new type overcomes the disadvantages of the older style, however, the British Army relies on a protective ointment for the feet and legs. A disadvantage of the ointment is the frequency with which it must be renewed on the heels and pasterns.

These protective devices are designed to be worn continuously when the danger of gassing is regarded as imminent or when traversing gassed areas.

In the treatment of established injury, removal of the mummified skin by excising is not advised. If the injury is slight, healing will proceed underneath it and when the plaque is exfoliated the wound will be practically well. In graver cases loosening of the injured part is encouraged by the application of cod liver oil, glycerine or packs wet in mild antiseptic solution. The use of astringents after the necrotic tissue is exfoliated is contraindicated. Applications that stimulate granulation, such as 1% solution of phenol, are desirable. Secondary infection should be prevented by protective coverings, if necessary, rather than by the use of antiseptics.

About 40 chemical warfare agents were used in World War I and an equal number have been developed since. However there are fewer than a dozen that are really important. The foregoing are representative of the various classes of important agents harmful to animals. Most of the important gases have a characteristic odor by which they may be identified if pure but since two or more poisons are often mixed and further the odor of any gas is easily disguised by harmless substances the odor test is unreliable. All larger organizations have Chemical Warfare Officers whose responsibilities include identification of chemical warfare agents. The decontamination of areas, buildings and inanimate objects other than food is also his responsibility. In measures for decontamination of food and the protection and treatment of animals the veterinary officer can usually obtain essential information from the chemical warfare service of his organization.

Chemical Aspects of Plasma Therapy In Veterinary Medicine*

THE addition of equine plasma to the armamentarium of the veterinarian seems to be indicated. Apparently the pathological influences which unbalance the fluid systems in the Equidae may be alleviated, at least in part, by the use of plasma —that portion of the blood which remains after the corpuscles have been removed. Recent investigations indicate that plasma maintains protoplasmic irritability, promotes the function of plasma proteins in capillary permeability and tone, and affords diuresis. It helps to maintain blood pressure, augments volume and buffer action, gives protection against shock, and aids in wound repair and in antibody formation.

Fig. 1. Plasma production unit of the 30th Veterinary General Hospital. A setup such as this adaptable to making blood plasma in the field. The portable stocks (right) is ideal to restrain the donor for drawing blood. The centrifuge (shown in the tent) is plugged into a small generator unit as is also a small refrigerator (not shown). One chest (shown in the tent at left), suitably arranged for carrying glassware and bottles, is easily prepared. Electric generator and refrigerator, table, chest, autoclave, towels, instruments, the tent, etc., are transport in the portable stocks when the hospital is moved.

The plasma contains all but a small portion of the 9% of total solids of the blood, since the proteins (albumins, globulin, fibrinogen, prothrombin) contribute 83% of the blood solids. Fibrinogen causes coagulation of the blood. The albumin and globulin fractions maintin the water balance between the blood and the tissues. This latter property is dependent upon the attraction for water which is inherent in proteins. It is true that the osmotic pressure of the plasma proteins is almost negligible when compared with that of the crystalloids; nevertheless the latter, unlike the proteins, play no role in the distribution of the water, because of the fact that they pass freely through the cellular walls. Capillary injury often brings about an abnormal partition in the body water by allowing the plasma proteins, as well as the crystalloids, to pass through the capillary endothelium into the tissue spaces. Investigations in dogs have shown that mechanical, thermal and chemical trauma, and oxygen depletion often cause increased capillary permeability.

The albumin, because of its smaller molecule and high molecular weight, and the fact that it is present in larger quantity, is more important in the distribution of water than is the globulin. The serum albumin maintains the colloidal osmotic pressure of the intravascular fluid by decreasing the porosity of the walls of the vascular channels. Once this protective mechanism is disturbed, the fluid balance between the intravascular and the extravascular fluids becomes disrupted. Furthermore, this disturbance is accompanied by an ingress or egress of cell fluid and its various inorganic cations and anions—sodium, potassium and the chlorides.

* By Lieut. John A. Utterback, Fort Bliss, Texas.

The intravenous administration of aqueous solutions dilutes the plasma chlorides in the blood to a concentration which allows the injected fluid to diffuse from the vascular stream; and reduces the protein concentration to an edema level. In this state of

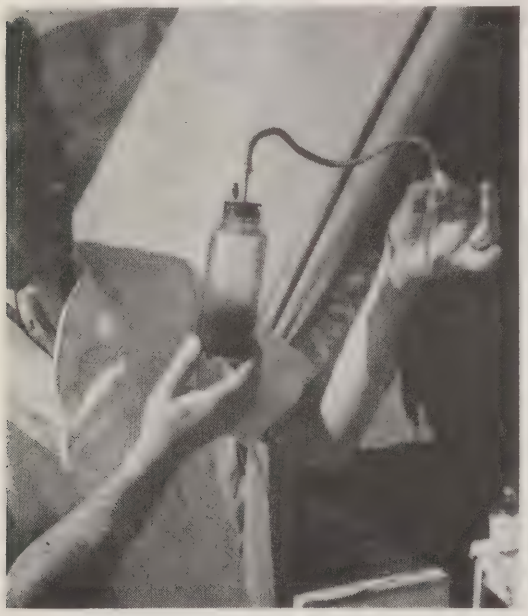

Fig. 2. Citrated blood in a 325cc centrifugal vacuum flask (centrivac) containing 35cc of 2½% sodium citrate solution. The centrivac, rubber stopper, intravenous tubing, needles and needle tube are washed thoroughly, assembled (as shown), wrapped in muslin and autoclaved for 30 minutes at 15 pounds pressure. Only after a donor is restrained and the area prepared along the jugular vein, is the muslin removed from the assembled, sterile units. The intravenous needle is then taken from the tube, flamed and immediately inserted into the donor's vein (Fig. 3)

hydremic plethora diffusible chloride ions and bicarbonates are thrown out of equilibrium.

In the state of health the base (potassium) resides largely in the cells of the body. Half of it is attached to hemoglobin; the remaining half is available for combination with chlorides and carbonates. In the plasma sodium is widely distributed, approximately one-tenth being attached to protein, the remainder available for combination with chlorides and carbonates. The concentration of the chloride ion in the blood plasma is twice that in the blood cells. However, the total of the osmotically active electrolytes is equal in cells and plasma. As the CO_2 tension of the blood is changed there is an altered distribution of the chlorine and bicarbonate between the cells and plasma. An increase of CO_2 increases the H_2CO_3, which combines with the base previously attached to the hemoglobin. This increases the additional formation of bicarbonate. The equilibrium is soon restored by some of the bicarbonate ions passing from the cells to the plasma and an equal amount of chloride leaving the plasma for the cells.

From this it may be seen that the chlorine (Cl) and the bicarbonate (HCO_3) ions pass through the cell membranes readily, whereas the sodium and potassium ions do not.

During the period of disturbed fluid balance the acid-base balance is not main-

Fig. 3. (Lieut. Utterback at right). The donor is easily restrained in the portable stocks. The area for the venepuncture is shaved, painted with iodine and the neck clothed with sterile towels. This area is exposed through an opening in the towels and the venepuncture made immediately. The blood is drawn into the centrivac containing the sodium citrate (Fig. 2 shows a small quantity of blood so drawn). As soon as the blood is drawn the bleeding needle is removed and the tube attached to the air outlet in the stopper as shown in Fig. 4

Fig. 4. Immediately after withdrawing the blood into the centrivac (Fig. 2) the intravenous tubing is disconnected from the bleeding needle. The hub of the needle or the glass tubing, as the case may be, which has been inserted into the stopper for the intake of air, during the assembling of the unit, is now flamed, as is also the disconnected end of the tubing which is immediately adjusted over the flamed needle or glass tubing. This procedure secures blood in a closed system. The assembly as it appears before and after use is shown

tained. The easily diffusible chloride ion becomes diluted and lost from the vascular tree and the cell membranes become permeable to potassium, resulting in its loss into the vascular fluids while at the same time sodium is retained in the body cells. In animal medicine we see various conditions that necessitate readjustments in the circulatory systems. Often, however, the compensatory capacity of the body is sufficient to forestall a fatal issue.

Among prevalent conditions involving circulatory pathology one may name dehydration, exhaustion, infections and shock. In fact, the latter may be defined as a condition of circulatory failure induced by trauma, by discrepancy in the size of the vascular bed, by inadequate intravascular volume or by tissue anoxia, to which many factors may contribute. One is forced to the conclusion that though the exact genesis of shock is obscure, it represents probably a group of circulatory failures of different origins, characterized by an acute oligemia.

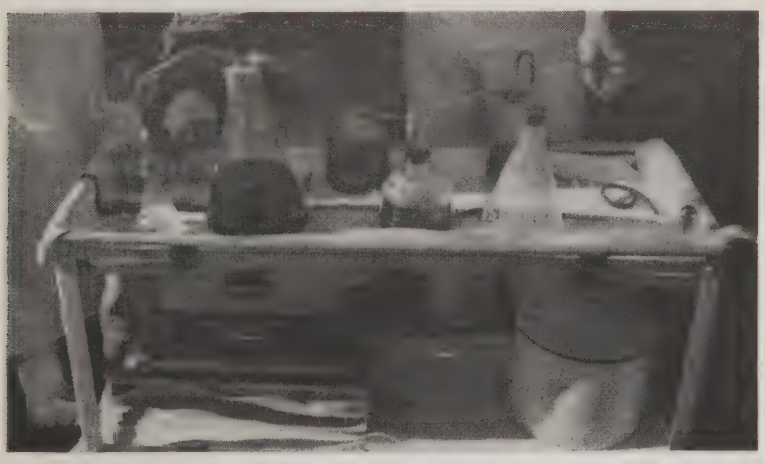

Fig. 5. Equipment for the transfer of the supernatant plasma from the blood clot into a sterile container from which it may be used immediately or stored for future use. The large Erlenmeyer flask facilitates the collecting of large volumes of plasma. After the citrated blood stands at 34° F. for 48 to 60 hours the clot settles and the supernatant plasma may be drawn off into a smaller centrivac (shown behind the Erlenmeyer flask at the right) and centrifuged to throw down the fibrin veil which does not settle out in this period of time. As a matter of practice the upper half or more of the supernatant plasma, after settling for 60 hours in the large Erlenmeyer flask, is suitable for use and is then drawn into the storage flask. It can be used then or later. The remainder of the plasma is drawn into the centrivac and centrifuged. It is then transferred to the storage flask (as the one shown in the center of the illustration) for immediate or future use. In the transfer from one flask to another a closed system of tubing is used and the plasma is never allowed to come into contact with air, except that which has been filtered through concentrated sulphuric acid or liquefied phenol. Where a good technic is employed contamination of the plasma is rare. Large quantities of it can be stored for several weeks with insignificant loss. However, the source from which to prepare plasma is usually so ample that it should seldom be necessary to store more than a week's supply. This can be maintained by scheduling plasma preparation one day each week. If desired the plasma may be dried readily with very simple apparatus and stored indefinitely

Plasma therapy holds forth a potential significance as a rational therapeutic advance in modern animal medicine. Plasma presents to modern veterinary medicine a method of control of the balance between the fluid systems in the body. Moreover, it contains protein, which is a component of every living cell and is the most valuable constituent of living protoplasm. The protein derivatives contained in plasma (albumins, globulins, amino acids, etc.) all yield nitrogen and are utilized in fundamental processes, such as preservation of proper osmotic relationships, sources of energy, synthesis of hormones, replacement of tissues and nutritional repair.

There are simple blood tests that reveal often considerably in advance of clinical symptoms when plasma injections are indicated.

Signal Corps, U. S. Army

Veterinary Officers at the Army School of Meat and Dairy Hygiene, Chicago, study beef grades

An "Army Marches on Its Stomach"

Army shoe repair installations, noting that in some organizations a pair of heavy service shoes requires new soles after only one week's wear, and replacement in a month, may question Napoleon's statement that an "army marches on its stomach." But whether it marches as Napoleon said or in the extremely upright position that drill sergeants think fitting, it marches on a product of animal industry.

As compared with magazine articles and radio broadcasts lauding the achievements of airplane and tank manufacturers, ship builders and shell makers, the producers and processors of food products of animal origin have received little publicity, yet their task is far greater than has ever before faced their industry. Their products are as important to the war effort "on the land, on the sea, and in the air" as any.

That we hear so little about it, is ample evidence that our beef, swine, sheep, dairy and poultry industries, and the processors of the products of these industries, are doing their job efficiently. Another evidence is that, whereas the supply of rubber, steel, all critical metals, machinery and a thousand other items of everyday use have been restricted for civilians, the native food supply has been ample for all. In the plans for rationing meat which it is expected will be in effect by the first of the year, an allotment of 2½ pounds per person per week is contemplated; this being the average civilian consumption for the past five years. The production of the six billion pounds of meat which will be required for the armed forces and for lend-lease during the present fiscal year must be thus solely a result of "war effort" and a tremendous effort it is. If in addition to supplying this huge volume of food for the armed forces and for lend-lease, the civilian population can still be provided with its average requirement, this record of the meat producing industries will stand unique among all great industries. None other has achieved it nor is there promise that any other will do so.

Incidentally it may be pointed out that the processing of this enormous quantity of food will be carried out under the supervision of the veterinary service. It will be inspected at purchase, at manufacture, at issue or shipment and its wholesomeness and grade certified to by this service, and not a pound of it can be paid for by the government except upon the certification by a veterinary officer that it meets government contract specifications.

Inspection of Meats for the United States Army

By LIEUT. COL. FRED C. WATERS, V.C.,
Depot Veterinarian, Chicago Quartermaster Depot

OFFICERS and enlisted men of the Veterinary Corps stationed at the Chicago Quartermaster Depot are responsible for the inspection of meat products prepared in Chicago to be consumed by the army. Of course this work has expanded greatly since the inception of the Defense Program and still more since the outbreak of war. A staff of 72 veterinary officers and 80 enlisted men is required to handle the contracts which are being awarded every day.

Any establishment dealing in the products the army needs is allowed to bid on Government contracts provided certain sanitary requirements are maintained. Packing houses which satisfactorily pass the inspection of the federal Bureau of Animal Industry are allowed to supply the army without further question as to sanitary conditions. In the event dairy products, fish, or poultry are to be furnished, the army makes its own sanitary inspection, which is conducted by a veterinary officer. The sanitary conditions which require investigation include suitability of site and surroundings —that is, the general cleanliness of the location, adequacy of water supply and draining facilities; the interior construction of the building—whether it is constructed of suitable material and is in good repair; ventilation; lighting; cleanliness and condition of equipment and utensils; disposal of by-products; and the handling, packing and transporting of the products. The employees of the plant are also subject to scrutiny in regard to cleanliness and health.

The initial step in the purchase of any product for the army is taken by the Purchasing Quartermaster. From the approved list of bidders—those business firms which have satisfactorily passed sanitary inspection—he selects the houses dealing in the products involved in a pending contract, and sends them an invitation to bid in which are stated the grade, quality and size, the Government specifications covering each product and the amount desired of each product. The date and place where the bids will be publicly opened and the contract awarded are included. On the date specified representatives of the houses who wish to bid gather at the designated place (usually at the Quartermaster Depot) and the bids are considered. The contract is awarded to the firm which makes the lowest bid. The successful bidder then receives a purchase order which states the time delivery is to be made and, in the case of meat, meat-food or dairy products, that inspection will be conducted under the super-

Signal Corps U. S. Army

The army purchases inconceivable numbers of eggs. All are inspected by veterinary officers at the time of purchase and again at issue to troops. Here two students in the School of Meat and Dairy Hygiene, Lieut. Jas. W. Heaton and Capt. Max H. Carlin are receiving instructions in egg candling

* Excerpts from an address by Lieut. Col. Fred C. Waters, V.C., Depot Veterinarian, Chicago Quartermaster Depot, at annual meeting of the American Meat Institute.

Signal Corps U. S. Army

The late Col. Will Griffin demonstrates inspection of smoked hams to a class in Meat and Dairy Hygiene

vision of a designated veterinary officer.

After a contract for a meat-food or dairy product is awarded by the Chicago Quartermaster Depot, our office is notified and a copy of the purchase order is supplied. If the product is to be prepared in Chicago our veterinary officers conduct the necessary inspections. Their work begins in the chill room where the meat is offered for sale. The initial inspection, in which the meat is graded to accord with specifications, is the most rigid given, and the most important. Meat passed for processing at that time will probably be finally accepted unless something develops during the processing. Products are house inspected before presented to the Veterinary Corps and if rejected is a loss to the packer.

Lately, the army has been purchasing huge quantities of frozen, boneless beef. For this the carcasses are selected in the chill room by a veterinary officer who places the army stamp of acceptance on those which meet specifications. The beef is graded as low, good, or No. 3, in conformity with rules of the American Meat Institute. Until recently, only steer carcasses were acceptable, but due to the huge quantities which are being purchased heifer carcasses also are being accepted at present. After selection in the chill room, the carcasses are taken into the boning room where they are quartered, cut and boned under the supervision of a veterinary officer and his detail of enlisted men. The meat is then wrapped and packed in a box with the weight and classification indicated and immediately placed in a sharp freezer with the temperature ranging from -17 to -22° F. However, shipments are not permitted to leave the plant until the meat is frozen solid. It is then transported in refrigerator cars. Upon its arrival at one of the refrigerator warehouses, which are located in various sections of the country, it is stored until needed by troops in that section. The use of frozen boneless beef has proved highly satisfactory as it minimizes shipping problems since the product requires much less space than that of other forms of beef.

Each article purchased by the Government is prepared according to specifications compiled by the Government. They are definite, and should be readily understood inasmuch as they are clearly worded; however, at times some difficulty has arisen with various packers regarding the interpretation of the specifications. In one instance a contractor made a bid to supply calf liver under the impression that the product involved was beef liver and he figured on beef liver prices. The Govern-

ment accepted his bid with no knowledge of the fact that the contractor intended to supply beef liver. Of course the meat packer had to deliver the goods in compliance with the contract even though he suffered a tremendous loss. Such gross disregard of contract specifications seldom occurs but when it does it causes a great deal of friction. As a rule the relationship between packer and inspector is a cordial one.

The Chicago Quartermaster Depot awards many contracts which are to be completed outside Chicago. If a contractor needs the services of a veterinary officer, and none is available in the immediate vicinity, he may request that an inspector be sent even from another corps area. The Corps Area Veterinarian assumes the responsibility of assigning an officer for the inspection.

At the direction of the Surgeon General's Office in Washington, our office in Chicago has become a center for supplying these inspectors. In the future, we expect to be sending out more and more officers, particularly on those contracts which are awarded by the Chicago Quartermaster Depot.

A standardized system of inspection throughout the United States is highly desirable. Ill-feeling is caused when one inspector accepts a shipment and the next inspector rejects it on some technicality. Such occurrences cause unfriendliness among the army inspectors as well as between the Government and the packers. Accordingly a School of Meat and Dairy Hygiene for Veterinary Officers was established.

The purpose of this school is to teach all veterinary officers a standard method of inspection which will insure the purchase of good food of uniform quality throughout the army. Such a system of inspection also affords protection to the meat packers by offering assurance that all packing houses are dealt with in the same manner. Each class is made up of approximately 20 officers who come from all parts of the country. The course of instruction is very complete and the school has functioned very satisfactorily.

The meat packers of Chicago have most willingly cooperated with the instructors in connection with the School of Meat and Dairy Hygiene. The officers attending this school have gained a great deal of practical experience by being allowed to use packing plant facilities, and also from the informal lectures delivered by packing house experts.

Signal Corps U. S. Army

CLASS IN THE ARMY SCHOOL OF MEAT AND DAIRY HYGIENE

Left to right: Lieuts. Geo. Snook, J. B. Couch, P. F. Landis, E. J. Sunderville, O. L. Bailey, B. B. Vail, W. S. Bentham, Myron Thom, H. D. Smith, A. W. Winter, Capt. M. H. Carlin, Lieuts. Mawwell, T. M. Eagle, Geo. Walmsley, Capt. V. E. Ishee, Lieuts. J. W. Heaton, J. J. Keane, E. A. Beckcom, Capt's. A. W. Crawford, R. Cook (Instructor) and Lieut. Col. Will C. Griffen (deceased) Director.

Army S. O. S. (Service of Supply) in the North Country

Signal Corps, U. S. Army

Although army personnel and army organizations have always possessed many dogs, these animals, for the first time, have become officially a part of the U. S. Army in the present war. Dogs are used extensively by the Russian Army to carry wounded soldiers to the rear. Few are wounded while performing this duty

Army Dogs

From time immemorial the dog has fought beside his master in the chase, in raids and forays, in tribal conflicts and in the greater wars that developed with the progress of what is known as civilization. The participation of dogs in man's conflicts has not been uniform. Sometimes it has been well organized and at others fragmentary. In the World War of 1914-18 dogs were used on a large scale by all the major armies except the American. The British army entered the war without dogs, but developed a dog service of high standing before it was over. The extent to which the Germans employed dogs is indicated by the fact that there were 16,000 casualties among these animals. The French used 8,000 dogs, chiefly for transport, in the Vosges Mountains alone. The Italian army possessed 3,000 well-trained dogs when it entered the war. The Belgians had the most complete dog service. It included sentry, patrol, messenger and evacuation duties and a large transport service. The peacetime organization included 12 dogs in each machine gun team, and 30-dog teams for small field-guns.

Soon after the outbreak of the present war several organizations, mindful of the outcry against the keeping of dogs in World War I, when there was inadequate food for the civilian population, set about promoting the use of dogs by our army. Soon all such effort was centered in Dogs For Defense, Inc. An extensive educational campaign in the newspapers was instituted and maintained. In a few months a program was adopted by which the army would acquire by gift 125,000 dogs over a period of years. The animals are collected by Dogs For Defense and shipped to the Remount stations at Front Royal, Va., Fort Robinson, Nebr,, or San Mateo, Calif. They are trained at these remount stations and issued as needed to army and navy organizations for use in sentry and patrol work. The training is in charge of the remount section of the Quartermaster Department.

It is generally thought that Dogs For Defense was responsible for the dog being given official recognition in the army. However eight months before Pearl Harbor without fanfare and almost in secret the army began acquiring sledge dogs for use in Newfoundland, Alaska and other northern bases. The sledge dogs are acquired by purchase, in northern New Hampshire and adjacent districts and trained at a camp in Montana.

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